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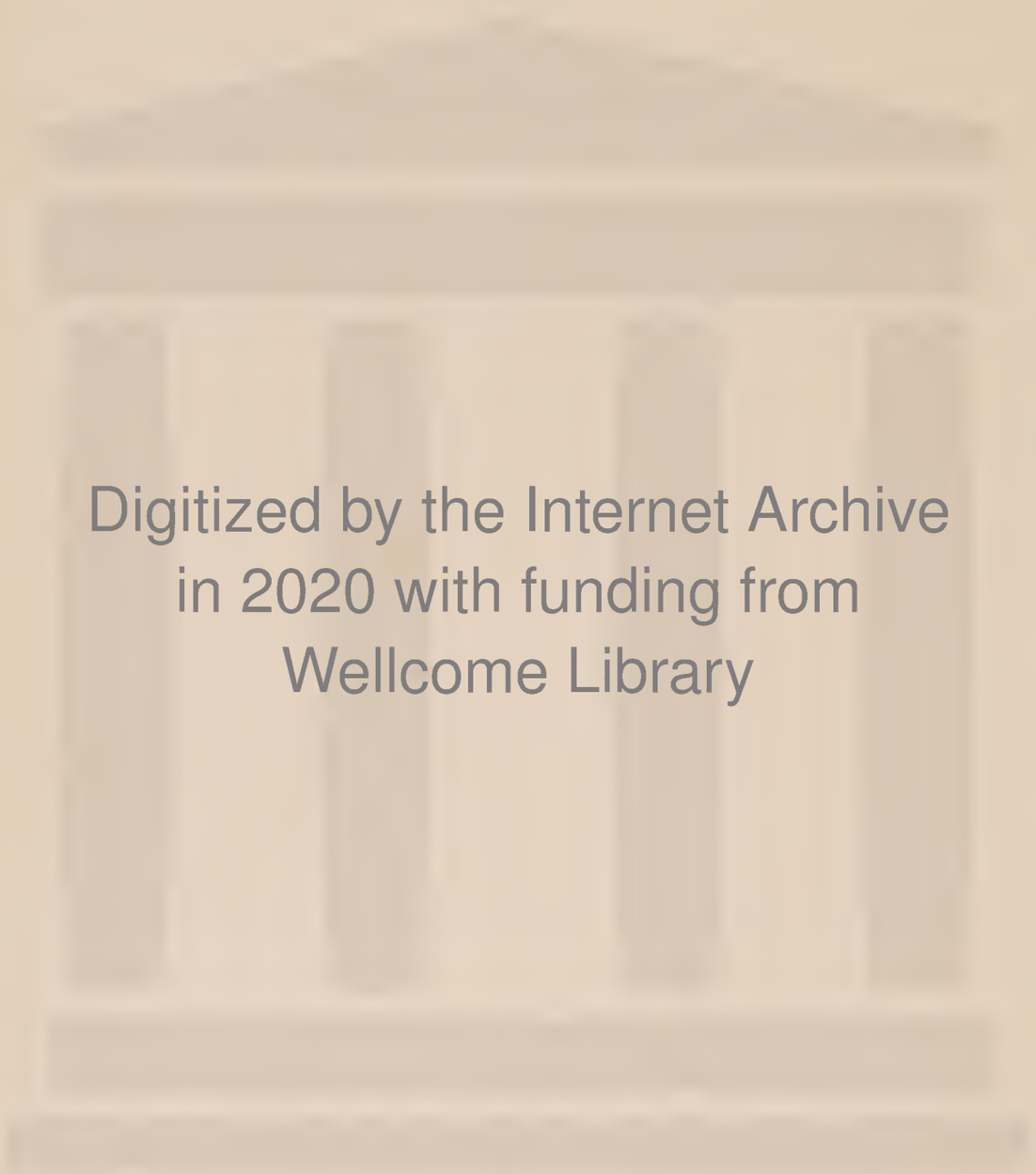
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THE MICROSCOPE.

AN

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DEVOTED TO

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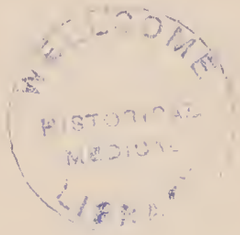

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VOL. VIII. DETROIT, JANUARY, 1888. No. 1

ORIGINAL COMMUNICATIONS.

THE MORPHOLOGICS OF COOKING.—POTATOES.

EPHRAIM CUTTER.

M. A. YALE, M. D. HARVARD, ET UNIV. PENNSYLVANIA, LL. D. IOWA, CORRESPONDING MEMBER SOCIETE BELGE DE MICROSCOPIE, ASSOCIATE MEMBER PHILOSOPHICAL SOCIETY OF GREAT BRITAIN, MEMBER AMERICAN SOCIETY MICROSCOPISTS, AMERICAN MEDICAL ASSOCIATION, ETC., AUTHOR BOYLSTON PRIZE ESSAY, 1857, CLINICAL MICROSCOPE PRIMER, GALVANISM UTERINE FIBROIDS, DIET IN CANCER, THYROTOMY MODIFIED, VERSIONS AND FLEXIONS OF THE UNIMPREGNATED UTERUS, ETC.

INTRODUCTION.

IN this paper it is not intended to give an exhaustive statement of the subject, as the potato is an underground stem that contains a compendium of all the structures that enter into plant histology ; but to make brief allusions to some of the points in which the microscope is an instrument of precision in relation to the effect of cooking upon potatoes.

The idea that the microscope has any place in a kitchen meets with some ridicule from those who have not looked into the subject and who forget that æsthetics govern the subject of food so that thousands are destroyed by bad food simply because it is pleasant to the taste and "good to the eyes."

Following out this line of conventional thought, if by the use of the microscope it is shown that there are real æsthetic beauties in the things ordinarily thought to be divested of any beauty, as the potato, one thing will be accomplished.

Say what we may, there are queens in our kitchens who govern the whole house. The foods prepared by them form the staple of

our lives. If we have poor food we are not well; if we have good food, properly cooked, then our lives run smoothly and in health. The evils of strong drink are great, but the evils of bad cooking and ill-selected food are greater. It is one of the curious things of our ethics that the really most important matters of our households are too often entrusted to the lowest intelligences we meet with in society; that when we hire cooks we trust our lives and health to persons who can neither read nor write (in many cases) and who do not have any clear idea of what they are about, save to get all the money they can, break all the crockery, and dress in what finery they can of a Sunday.

Would that the time spent by the queens of our parlors on crazy quilts, screens and fancy needle work (well enough in their place) was given to the solution of the beautiful problems connected with food that are so vitally important and constantly pressing on our attention every time we eat.

MORPHOLOGY OF THE POTATO.—UNCOOKED.

By potatoes we mean (1) the tubers of the *solanum tuberosum*, the commonly called Irish or white potato—a native of South America, and (2) the sweet potato, a native of the Malaga Peninsula, *botatas edulis*, or the *convolvulus batatas* of Linnaeus.

If we take (1) a tuber which has a covering (good enough to be patented) of an epidermis, made up of cork cells, which are elastic, protective and capable of reproduction to a certain extent, when mutilated or destroyed; this skin is made up of layers superimposed in oblong right-angled cells, much like common brick-work, and unlike the cork cells of the common bottle cork (*quercus suber*). In form the potato skin is an admirable covering and perfectly adapted to its use. At various points are the so-called eyes, each of which is connected by gubernaculum lines of spiral tissue connecting with the central part of the stem (Reinsch).

A thin section of the potato discloses a beautiful network of connective fibrous tissue, looking much like the meshes of a common fish net. This net work is filled with starch grains in all stages of development, from the most minute granules to the large concentrically marked pear-shaped grains. Under polarized light these sections of raw potatoes form one of the most beautiful objects witnessed under the microscope, comparing favorably with an Italian sunset or a rainbow. That such a lovely object can be found in the homely domains of the kitchen is ignored by the queens both of the parlor and kitchen!

But it is none the less an argument in favor of the microscope, which transmits ideas of the real character of things which have no reputation for their really æsthetical character—like potatoes that grow in the ground, smothered in manure !

WHITE POTATOES.—COOKED.

Whether cooked by steam, boiling water or the heat of frying fat, a wonderful change in the morphology of the raw potato is effected, more or less complete, according to the time and thoroughness of the process. When thoroughly done, the parts that looked like the interspaces of a network filled with distinct and separate starch grains of various shapes and sizes, as aforesaid, now appear in new phases as sacs or obovoid bundles, distinct, free and differing in shape according to the demands of the spherical geometry that obtains in the building up of the tuber. Fig. 1.

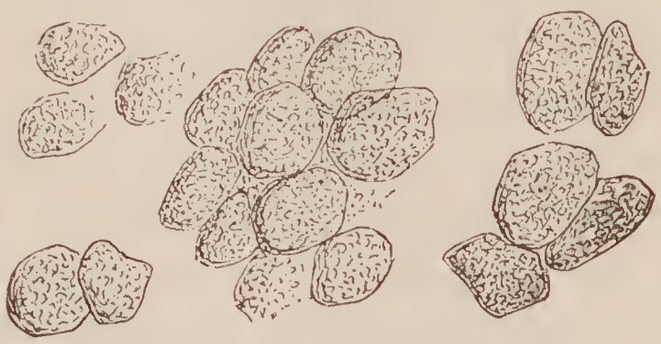


FIG. 1. White Potato, cooked by boiling. One inch objective, 1½ inch eye-piece.
All these figures drawn from object by Mrs. Mary Smith, *neè* Chapin.

The inside of the sacs are filled with the starch grains. It seems as if the outside wall of the sacs was made up of the cellulose fibers which, before the action of the heat, formed the network aforesaid. How it is that the fibers and strings of this network are turned by heat into a complete sac is hard to understand, because there seems to be a running of separate fibers from one space to others.

FIG. 2. Baked Potatoes. ¼ inch objective. 1½ eye-piece.

Still the fact remains ; the sacs seem to come out as smooth and complete as the shell of an egg, only that the sac wall is clear as glass and polarizes light.

If the cooking process is not complete, the following facts are noted under the microscope :

1. The starch grains are distinct and have interspaces between them.

2. They polarize light.

If the cooking is complete, the following facts are noticed :

1. The starch grains are broken up into one homogeneous, well-mixed mass.

2. They do not polarize light.

In proportion to the presence or absence of polarization of light and in proportion as the starch grains are broken up more or less, is —*morphologically the perfection of the cooking.*

FIG. 3. Fried Potatato, "Saratoga Chip," with crystals in substance.

3. Another effect of cooking is: When the heat is as high as in frying or broiling—to contract the starch grains into a semi-solid, aufractuous, protoplasmic mass, leaving between the sac wall and itself clean margins of empty space, or filled with clear, translucent, protoplasmic matter, which does not polarize light. Fig. 3.

The cuts show this difference pretty well. The starch grains are ruptured and fused into one amorphous mass, and yet a little different from the same when baked or boiled.

So that in this way the microscope becomes a testing medium for the cooking of pototoes, of the finest description.

It supplements or should not be divorced from other tests, as the chemical, by showing the presence of glucose or dextrine, or the tests by touch of tongue, teeth, finger, fork or skewer—as to softness.

Another test of cooking of potatoes is the morphology of the feces of the eater. See figure.

It is surprising to see how many of the potato sacs run the gauntlet of digestion because not thoroughly cooked. To be sure they are not so tough as the sacs of baked beans,* (Fig. 4) which are found to be very much more indigestible by the morphology of the feces, still so long as mankind have to eat to live, and so long as cooking can can properly prepare food so that it will be digestible, it seems folly for mankind to overlook the tests of good cooking.

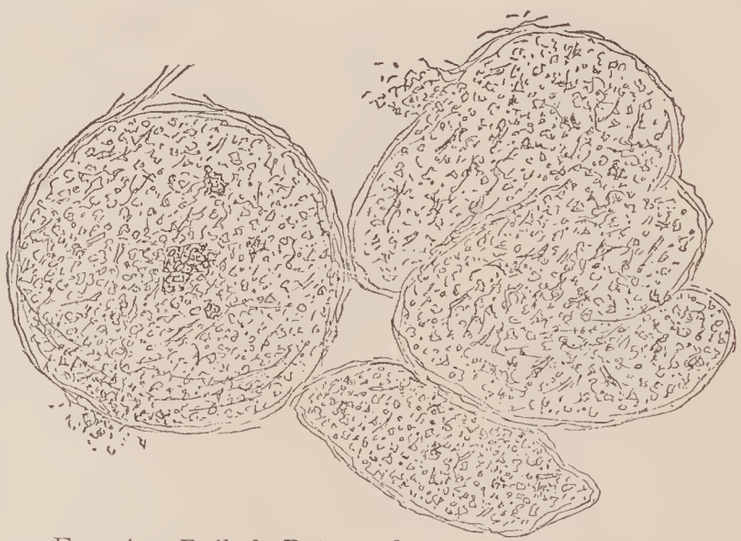


FIG. 4. Boiled Potato from human faces, that resisted digestion.

*BAKED BEANS:—A serio-humorous medical paper, *Albany Medical Annals*, March, 1887. NEW YORK.

To give the intestines alimentary problems to solve, which should be solved by cooking, is putting man between two mill-stones, on of which may represent the inevitable battles of life without the body, and the other the needless intestinal wars within, the latter uselessly handicapping from the outset. Fig. 5.

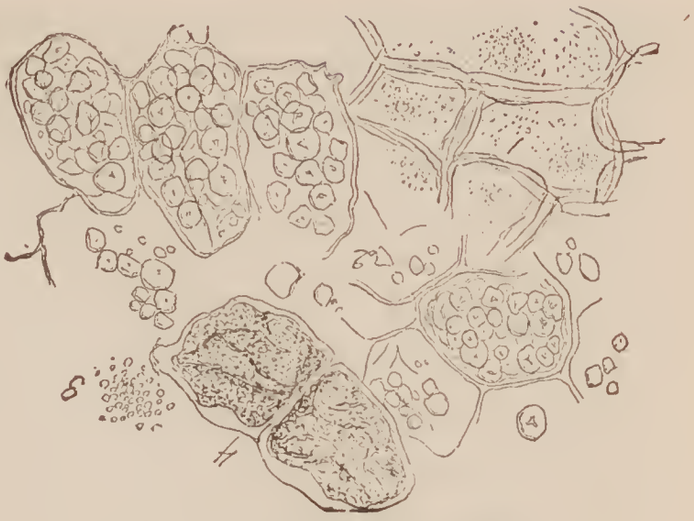


FIG. 5. Sweet Potato. Raw.

FIG. 6. Sweet Potato. Cooked.

As to the sweet potato.—It is interesting to note the difference between the raw and cooked, as shown by figures 5 and 6. There is the same reticulation in the raw and the same formation in the cooked as found in the white potato, whose stems are clustered stalks, while the sweet potato is a climbing vine. Fig. 6.

THE ARISTON, BROADWAY AND 55TH STREET, NEW YORK, NOVEMBER 12, 1887.

HOW TO MOUNT A TAPE-WORM.

W. S. JACKMAN.

A JOINT or segment of tape-worm, mounted in the following manner, will show the ovaries and eggs very clearly. Procure good-sized specimens with well-filled ovaries. Remove from the alcohol in which they have hardened, wash, and immerse in glycerin for a few days, until clear and pulpy in appearance. Place between two strips of glass and squeeze until the specimen is quite thin. Clamp with a stiff spring clothes-pin and allow it to remain thus for several hours—a day is not too long. Sufficient glycerin will adhere to the glass to keep it moist; next place in the stain; a few minutes will usually be long enough. Pass it then through the fixing solution,

and place in oil of cloves; allow it to remain here until the tissue around the eggs assumes a transparent, glassy appearance. Then remove to a thin balsam solution and mount at pleasure. Turpentine does not seem to answer for clearing purposes, as it made all the specimens that I immersed in it, quite opaque. I have mounted a number of specimens, prepared as above described, in "Hard Finish," recommended by Mr. Seaman at the recent meeting of the A. S. M., and it appears to answer the purpose as well as balsam, is pleasanter to handle, and easier to prepare. It may be obtained of any dealer in painters' supplies, and is prepared by being thinned with benzole, and then filtered. If perfectly free from small particles of dust, when bought, even this latter precaution is unnecessary.

HIGH SCHOOL, PITTSBURGH, PA.

APOCHROMATIC OBJECTIVES.*

ERNST GUNDLACH.

THE almost generally prevailing opinion, that the microscope objective has been brought so near to perfection as to leave little or nothing for its further improvement, has been greatly modified by the appearance of a new and superior material of which to construct optical lenses — the apochromatic glass of Schott & Co., of Jena, Germany. The fact that this new glass has solved the long-pending problem of removing or reducing the secondary spectrum, has naturally aroused the most sanguine hopes for a general improvement of the microscope objective. These hopes would doubtless long ago have been realized, through the efforts of the able opticians of the world, if the new glass did not have, aside from the great virtue of reducing the secondary spectrum to a minimum, some serious drawbacks not connected with other optical glass. In fact, if the new glass were, or could be made, in every respect similar to the ordinary optical glass, the objectives could be made of it in exactly the same manner and after the same formulæ as they are now, and their optical qualities would be just the same in every respect, but, with the secondary spectrum considerably reduced, and, consequently, the definition greatly improved. But, unfortunately, this is not the case. In my paper, at last year's meeting, I pointed out the fact, derived from figures of the refractive and dispersive powers of the new glass, as furnished by the makers, that the proportions of powers were such as to require extremely short curvatures, which would produce a very

*Read before the American Society of Microscopists, Pittsburgh, Aug, 30, 1887.

injurious amount of aberrations of the second order, and, that this error would probably overbalance the advantages of the reduced secondary spectrum. Since that time, however, I have tried the glass, and found my assertion to be correct. Indeed, it could not well be otherwise, as figures seldom lie. In fact, it would be impossible to construct from the new glass microscope objectives of superior quality after the usual or known plans. Our present low powers, for instance, from half inch down to three or four-inch, are now almost universally constructed after the dialytic principle, being two widely-separated systems, each consisting of a cover and flint glass of moderate optical powers and fooming an achromatic lense, or nearly so, for itself. This objective has almost perfect optical symmetry and forms, therefore, a very even and flat field of fine definition and brilliancy. No addition of lenses, nor any change of form could improve this objective, but would rather impair its quality. But the new apochromatic glass is entirely unfit for this form of objective, for the reasons heretofore given. I was led, therefore, to consider whether another form of construction could be found to which the new glass could be advantageously adapted, and I have succeeded in solving the problem so completely that, for theoretical reasons, I do not hesitate to claim my new formula to be the only proper one for the new glass. My new apochromatic objectives contain at least one triple lense of my new construction, adapted to the new glass. The $\frac{1}{8}$ inch is a homogeneous, immersion objective of 1.42 N. A., and $\frac{1}{50}$ inch working distance. It contains two triple systems and two single lenses, of which the back system is constructed after my new invention. Of this objective seven lenses are made of the new apochromatic, and the eighth of another new glass. The $\frac{1}{4}$ inch is a dry working objective of 100° aperture. It is a three-system, and all but one of its lenses are made of the apochromatic glass, the back-system being a triplet of my new form. The low powers are constructed after the dialytic, and consist or two triplets, both of my new form. Thus these objectives are made entirely of the new apochromatic glass. These new dialytic objectives, aside from being practically entirely free from any disturbing color, and in every other respect fully equal to the ordinary dialytic of the best quality, are far superior to any objective in flatness of field, and are, therefore, unlike the European apochromatic objectives, in less need of "compensating eyepieces" than the best ordinary objectives.

As a very important advantage of the new apochromatic objective over the ordinary one, I regard the absence of a separate chemical

focus, which quality makes the objective especially adapted to photographic work. A one-inch has recently been tested photographically, with a distance of seven and one-half feet between the objective and the image, and not a trace of the usual difference between the visual and active foci could be found, and the resulting picture was of unusual sharpness and brilliancy.

ROCHESTER, N. Y.

DAVID SIMONS KELLICOTT, PH. D., F. R. M. S.

PRESIDENT OF THE AMERICAN SOCIETY OF MICROSCOPISTS.

(With Portrait.)

LEE H. SMITH.

THE writer's acquaintance with the subject of this sketch dates back to December, thirteen years ago, when, through the instrumentality of Mr. Henry Mills, our local father of microscopy, we were introduced. Afterward, in the course of a conversation with Mr. Mills, he remarked: "Prof. Kellicott purchased a microscope about a year ago, and has made the most remarkable progress in its study, and in its use as a means of investigation, of any one I have ever seen." Previous to this time, the Professor had devoted his time to teaching of science, and as a relaxation pursued the study of our local botany and entomology; but since he began work with the microscope, the results of his labors have been a wonderful example of what painstaking investigation and original work can be done, even when carried on by one apparently fully occupied by professional cares.

It is unusual to find, in this day of eager money-making, a man who, apparently casting aside all efforts for gain, devotes so much of his leisure and income to scientific study.

Among the valuable papers presented by Professor Kellicott to the scientific world, we can mention but a few, collected at random from a large number, all of which are of importance.

Among those published in the *Canadian Entomologist* are: "Observations on Several Species of Ægeridæ and Descriptions of Ae. Pini," xiii, 3–8; "The Larvæ of Catocala Unijuga," xiii, 38–9; "Notes on Ægeria Pini," xiii, 157; "Psephenus Le Contei—External Anatomy of Larvæ," xv, 191–8; "Ovipositing Apparatus of Nonagria Subcarnia," xvi, 170; "Eumacuria Brunnearia," xvii, 32–3.

In the *Entomologica Americana:* "Notes on the Larvæ of the Genus Catocala," ii, 45–6.

Yours,
D. A. Kellicott

In "Proceedings of the American Society of Microscopists:" "On Certain Crustacea Parasitic on Fishes from the Great Lakes," 1878, p. 53 *et seq.;* "Observations on Lernæocera Cruciata," 1878, p. 64 *et seq.;* "Lernæocera Tortua, N. Sp.," 1880, p. 41 *et seq.;* "On Certain Crustaceous Parasites of Fresh-Water Fishes," 1882, p. 75 *et seq.;* "Polyzoa—Observations, on Species Detected near Buffalo," 1882, p. 217 *et seq.;* "Infusoria Found on the Cray Fish," 1883, p. 105 *et seq.;* "Cothurina Lata N. Sp.," 1883. pp. 113—144; "Notes on Two Parasites of the Cray Fish," 1883, p. 115 *et. seq.;* "Observations on Infusoria, with Descriptions of New Species," 1884, p. 110 *et seq.;* "Notes on Infusoria, Rotatoria, Etc.," 1884, p. 115 *et seq.;* "Observations on Some Fresh-Water Infusoria, with Descriptions of a Few Species Regarded as New," 1885, p. 38 *et seq.;* "A New Floscule," 1885, p. 48.

In THE MICROSCOPE: "An Unusual Infusorian of the Family Vorticellidæ," iv, 248 *et seq.;* "Notice of Some Fresh-Water Infusoria," vol. vii, 225.

In *Bulletin B. Soc. of Nat. Sciences:* "Descriptions of a New Species of Argulus," (*A. lepidostei*) vol. iii, 214.

In *American Journal of Microscopy:* "Argulus Stizostethii," vol. v, 53; "A New Rotifer," (*Anurecæ longispina*) vol. iv, 19.

The microscopic life in the Buffalo water supply has been thoroughly investigated by him, season after season, and numerous are the notes and valuable researches made by him upon this subject.

He had made a painstaking examination, both chemically and microscopically, of the impure supply of well-water in certain districts of the City of Buffalo, which afterward led to their further study, and his results being verified, they were closed by the board of health.

In addition to his labors as Professor of Natural Science in the Buffalo State Normal School since 1871, and Professor of Botany and Microscopy in the College of Pharmacy, University of Buffalo, for the past two years, where his lectures have gained for him a widespread reputation as a thorough and exact teacher, he has by unanimous vote been elected on twooccasions President of the Buffalo Society of Natural Science, for the past two years, and has been in various positions connected with this society since his residence in Buffalo began. During this time he has been the means of a reorganization of the work of the society.

His high reputation is the result of many years' faithful performance of every service that he has undertaken, in all which he has evinced a conscientiousness that is relied on by every one. The

following anecdote is told of the professor's thorough attention by an eminent specialist. Being called up early one snowy December morning, he met the tall form of the professor striding through the snow on his way down town from his residence, which is situated some distance from the business center. In response to an inquiry as to what on earth brought him out at such an hour, and in such weather, he stated that "last night in thinking over the reading of a proof that is being published for the American Society of Microscopists, I remembered to have failed to see to the position of a comma in one of the sentences. I am on my way to the printer's to be sure of this, as it makes some difference in the meaning of the sentence." This illustrates, and is the key, to the professor's popularity and success.

Possessed of a rugged frame, and with an enormous capacity for hard work, and an untiring industry, there is little that has been left undone by him in general scientific study that is necessary to a thorough scientific training. He is one of the believers in evolution that have retained their belief in the Christian religion, which position he has worthily sustained in many sharp debates.

At the tenth annual meeting, held in Pittsburgh, he was elected president of the American Society of Microscopists—an honor which has been well merited by his painstaking work as secretary and editor of the annual volume of the society's proceedings for the past six years.

He was graduated at Genesee College, now Syracuse University, in the class of 1869, at which institution he has since earned the degree of Ph. D. on examination.

He is a Fellow of the American Society for the Advancement of Science, and has been President of the Entomological Club of that society.

PROCEEDINGS OF SOCIETIES.

THE SAN FRANCISCO MICROSCOPICAL SOCIETY.

THE regular meeting of this Society was held October 12, 1887, President Ferrer in the chair.

A letter was read from Isaac C. Thompson, F. R. M. S., of Liverpool, England, concerning the announcement that interesting Sandwich Island material will come into possession of the San Francisco Society. Mr. Thompson desires to secure material for the study of minute crustaceans, a special line of investigation which he has

pursued for some time, and upon which he has made valuable reports to the Liverpool Microscopical Society. His letter gave suggestions as to the use of the tow-net in obtaining the gatherings, and prescribed the following as a solution best fitted to preserve specimens of marine life : Water, one part; proof spirits, two parts; glycerine, one part; with one per cent. of carbolic acid added. By securing gatherings from the Pacific Mr. Thompson hopes to add to his previous finds of new *copepoda*, which constitute the chief part of pelagic life. In an expedition to the Canary Islands Mr. Thompson captured from forty to fifty new species. The San Francisco Society will endeavor to obtain the material which is neces sary for the study proposed by Mr. Thompson.

An interesting letter was read from W. F. Barraud of Wellington, New Zealand. The Wellington Microscopical Society meets fortnightly, and its members are now making special effort to investigate and catalogue the fresh water infusoria found in the district. Several interesting diatomaceous deposits occur in New Zealand, one at Oomaru being celebrated for its richness. Specimens of this earth have been quite widely distributed and mounted slides of it have been shown in the San Francisco Society meetings. Mr. Barraud sent a sample of the earth, which will be worked up by Mr. Riedy, and a sample of the Nevada salmon-colored diatomaceous earth, found some time ago by Professor Hanks will be sent to Mr. Barraud in exchange.

The chief part of the evening was given to an exhibition of high-power objectives recently received. Dr. Ferrer gave an outline first of the claims made for the apochromatic objectives and eye-pieces made with special kinds of glass by Zeiss of Jena. After a conversational discussion of the points advanced, the Zeiss glasses, one-twelfth, were shown by Drs. Ferrer and Mouser, and Dr. LeConte used Spencer's one-tenth and one-eighteenth. Various objects were examined, including test diatoms and bacteria, and the work of the glasses very favorably commented upon. It was not intended to attempt to arrive at any definite and formal work of the glasses, but rather to give all members an opportunity to examine for their own satisfaction. Dr. Mouser worked his Zeiss' one-twelfth up to 2,250 diameters with most admirable effects. The performance of the Spencer glasses was also very satisfactory.

Meeting October 26, President Ferrer presiding.

Dr. Ferrer continued his demonstrations of new accessories, of which a part was given at the last meeting of the society. He had

just received from Zeiss of Jena a number of low-power objectives and oculars. These are apochromatic and are made of the new glass the invention of which excited so much interest a year or so ago.

Besides the lenses for ordinary use to the microscope, Dr. Ferrer exhibited projecting eye-pieces which are inserted in place of the ordinary eye-pieces when the instrument is used in connection with a micro-camera for photographing. Dr. Ferrer said he had but just received the glasses and not fully tried them, but in his preliminary tests of their powers he was convinced of their wonderful definition. Comparative examinations were made of the Zeiss ordinary eye-piece and the "compensating eye-piece," which occupied the members for a long time and afforded much material for discussion.

THE ST. LOUIS CLUB OF MICROSCOPISTS.

THE regular monthly meeting of the club occurred at the College Tuesday evening, December 6.

The attendance was large and the usual enthusiasm manifested by the members. J. C. Falk had a pathological specimen of urine and explained the method of microscopically examining the same. A. C. Speth exhibited specimens of powdered tobacco and crystals of cumerin found on commercial vanilla. Frank Davis presented specimens of adulterated drugs. Other members added to the interest of the evening.

The club's collection of specimens is steadily growing by donations from the members.

At the next meeting, which occurs Tuesday evening, January 3, subjects will be discussed by D. L. Haigh, Wm. Ilhardt and H. M. Whelpley.

STATE MICROSCOPICAL SOCIETY OF OHIO.

AT the meeting held November 25, 1887, in the Library of Starling Medical College, Columbus, Dr. H. J. Detmers gave an interesting talk on the method of determining the qualities of objectives. Dr. F. O. Jacobs described the construction of his well-known freezing microtome, and explained its superiority over other instruments of this class. Several slides of bacilli were exhibited.

ELEMENTARY DEPARTMENT.

A COURSE IN ANIMAL HISTOLOGY.

BY FRANK W. BROWN, M. D.,

PROFESSOR OF HISTOLOGY AND MICROSCOPY, DETROIT COLLEGE OF MEDICINE.

FIRST PAPER.

DURING the present year the writer will attempt, in a series of papers in this department of THE MICROSCOPE, to give, for the benefit of those of its readers who may be desirous of entering on the study of animal histology, the simplest approved methods for the preparation of animal tissues for histological purposes. To this will be added a short description of the tissues thus prepared, made clearer through the aid of illustrations taken from specimens in the laboratory of this journal. The drawings will be as accurate as possible, truth not being sacrificed to beauty nor to the specious clearness of the diagram. It will be taken for granted that the reader has mastered the lessons given in this department last year, or that he has otherwise gained an elementary knowledge of microscopical technique. No space, therefore, will be given to A-B-C technique, though careful descriptions will be devoted to more elaborate methods, however slightly they may differ from those supposed to be known to the reader. The writer will be pleased to answer any inquiries relating to the lessons, and will be thankful for any suggestions which may aid him in presenting a clear idea of the subjects under discussion.

PREPARATORY. THE TABLE.—To do systematic work requires that a special table be devoted to the purpose. It should be used for nothing else, and the objects collected on it should not be touched or "arranged" by a servant or any one other than the worker. It should have an unfinished pine top, about three feet square. This will be found of convenient width and considerable depth. The deeper portions can be used for the arranging of chemicals and various utensils. This is better than having shelves or stands for their reception, especially if they are joined to the table, for in that case they will add to its instability. A shallow drawer may be constructed for the reception of instruments, etc. The writer prefers, however, that no drawer be used, for the reason that the drawing of it out at critical moments may greatly inconvenience the worker. In its place he recommends a number of bell-jars of various sizes (this number

should be at least 15 or 20 and should include those from 2 to 8 inches in diameter). All instruments, slips, cover-glasses, specimens in various stages of preparation, etc., can be kept under them, free from dust and easily accessible, as they are in view. The table should be of medium height—about 2 ft. 6 in.—and firmly set.

LIGHT.—The table should face a window of ample dimensions, provided with shades to cut off direct sunlight. It makes no difference what exposure the window may have, so that light is admitted in sufficient quantity. The ideal light is said to be that reflected from a white, cumulous cloud; but as clouds cannot be manufactured to order, it is as well to ignore them altogether and, by means of good shades, command a more reliable if not a better light. Artificial light is to be avoided when practicable, especially when working with the microscope. In the latter case it is not only more trying to the eyes, but it renders objects more difficult of study. Colors are not so well defined by it, and even with the use of a good condenser, has a tendency to create shadows in the specimen. All results obtained through the aid of artificial light should be confirmed by true light. Lamp light is better than gas light, being softer and steadier. The electric light, now being so generally introduced into private residences, may prove the best, though the writer has had no experience with it. An ordinary lamp will serve every purpose so long as the light given by it is steady. A bull's-eye lamp furnishes a most satisfactory light for use with the microscope, especially when high-power objectives are employed. Among the best of these is one manufactured by J. W. Queen & Co., of Philadelphia, called the "Acme." It is simple and cheap and answers every purpose. To correct the color and render the rays of artificial light more parallel several expedients have been proposed. One of the best of these is a glass globe, from 4 to 6 inches in diameter, filled with a solution of ammonia-sulphate of copper. This solution is made by dissolving a quantity of sulphate of copper in water and adding a few drops of ammonia. This will give a beautiful blue color. The globe thus filled can be placed between the light and mirror. Somewhat more simple, though not so effective, is a blue slip placed under the slide. When using the microscope, never employ any more light than is necessary to give a distinct view of the object. As the reader is supposed to be familiar with the use of diaphragms, nothing need be said on this point.

THE MICROSCOPE.—For actual work the microscope should be of the simplest construction possible. The numerous patent appliances,

which do not always work well, though in favor with many, serve only to render the worker more dependent. The instrument should be low set, so that it can be used without the necessity of one's rising from the chair or craning the neck to a point of inconvenience if not of pain. Many stands are provided with a hinge, by means of which the body of the instrument may be inclined at any angle, thus obviating the neck-craning act. When working with fresh specimens, however, the stage cannot be inclined, and it is just as well not to use the hinge at all. An achromatic substage condenser is now considered indispensible, particularly in bacteriological investigations. The Abbe condenser, made by Zeiss of Jena, is the best known of these, but the writer has examined one made on the same principle by Bausch & Lomb, of Rochester, N. Y., which is fully the equal of the foreign make.

LENSES.—In ordinary histological work it is not necessary to employ very high powers. One should always use the lowest power which will enable him to see the details of the object he may desire to study. As the high-power objectives are very expensive, the worker can, therefore, dispense with them until he has reached a more advanced point in the study of histology. Two eye-pieces, A and C, and three objectives, 1 in., $\frac{1}{2}$ in. and $\frac{1}{5}$ in., will make a serviceable set. The addition of an $\frac{1}{8}$ in. objective to the above will furnish any power required for ordinary work. Do not buy cheap lenses with the idea of getting a bargain. Buy the best you can afford. So important is this matter of good lenses, that the beginner will do well to consult an expert before purchasing.

(To be continued.)

RUDIMENTS OF PRACTICAL EMBRYOLOGY, BEING WORKING NOTES, WITH SIMPLE METHODS FOR BEGINNERS.*

W. P. MANTON.

IN the following articles a few tried and practical methods for preparing embryos for microscopical examination will be offered the student.

Embryos are so easily obtained that even in our largest cities there need be no dearth of material; and the short account of the development of the domestic fowl, with which these articles will be brought to a close, will give the beginner an idea of what he ought to see.

*Copyright, 1888.

For later periods of incubation than those mentioned, the reader must consult such works as Foster and Balfour's "Elements of Embryology," Balfour's "Comparative Embryology," or the less voluminous work of Prof. Packard, "Outlines of Comparative Embryology," all of which should be found in every public library of any considerable size.

It is supposed, of course, that before taking up the subject of which these papers treat, the student has familiarized himself with the use of the microscope and microscopical technique, as already taught in the Elementary Department of this journal.

SECTION I.

APPARATUS :—REAGENTS.

§ 1. Embryology, from the Greek words Εμβρυον, an embryo, and Λογος, a treatise, treats of "those successive modifications through which the organism passes in its development from the germ to the adult form."

It is a most important branch of biology, and concerns the development both anatomical and physiological of every living object.

In the present series the embryology of the domestic fowl has been chosen to initiate the beginner into the subject, for two reasons; first, because eggs can be procured at all times and in all places; and second, on account of the ease with which the microscopical appearances can be made out.

§ 2. The necessary apparatus is such as may be found in the armamentarium of the general microscopist, and will be mentioned in the descriptions of the methods given.

Certain reagents, etc., however, must be at hand. These are:—

(*a*). A one per cent. solution of common salt.

(*b*). A three per cent. solution of chromic acid.

(*c*). A solution of osmic acid.

1 cc. of a one per cent. osmic acid solution.
100 cc. water.

Mix.

LABEL.—Osmic Acid Solution.

N. B. Keep in a dark glass bottle, or cover the bottle with black paper or plush, as the solution soon deteriorates in the light.

(*d*). A solution of picric acid.

100 cc. of a cold, saturated solution of picric acid.
2 cc. of concentrated sulphuric acid.
Filter, and add
300 cc. distilled water.

LABEL.—Kleinenberg's Picric Acid Solution.

(*e*). Clove oil; turpentine oil; xylol or benzolene; spts. chloroform; Canadian balsam; hydrochloric acid, conc.; wax, hard and soft.

The latter is yellow wax to which enough Venetian turpentine has been added to give it the consistency of putty.

(*f*). Paraffine.

Several ounces of each of those, having melting points at 45° and 55° C., or the hardest and softest to be had in the shops. These are to be mixed according to the temperature of the work-room, usually two parts of the hard to one of the soft.

(*g*). Alcohol of 70 per cent., 95 per. cent., and absolute (Squibbs) strength.

(*h*). A thin solution of pure India rubber in chloroform or benzene (Threfall).

(*i*). A thin solution of shellac in absolute alcohol.

(*j*). Gun cotton collodion.

Gun cotton (photographer's)	2 grams.
Sulphuric ether	15 cc.
Alcohol, 95 per. cent	10 cc.
Clove oil	100 cc.

Dissolve the gun cotton in the ether and alcohol, add the clove oil, and filter. (Gage.)

(*k*). Borax carmine.

1 litre 70 per cent. alcohol.
1 litre distilled water.
25 grams carmine.
40 grams borax. (Grenacher.)

Cook over a water-bath, and when cool, filter. Keep in a well-corked bottle.

(*l*). Alum carmine.

100 cc. of a five per cent. aqueous solution of alum.
1 gram carmine.

Boil, and when cool filter; add a few drops of carbolic acid; cork tight. (Grenacher.)

(*m*). Hæmatoxylin.

Hæmatoxylin, saturated alcoholic solution 4 cc.
Ammonia-alum, strong saturated solution. 150 cc.

Let stand eight days; filter, and add

Glycerine ..... 25 cc.
Methyl-alcohol ..... 25 cc.

This stain works best after standing for some weeks or months. (Grenacher.)

(To be continued.)

EDITORIAL.

LOCAL MICROSCOPICAL SOCIETIES.

ALL of our readers are familiar with the American Society of Microscopists, its aims, and the results accomplished by it. By the meetings of this society, microscopists from all parts of the country are annually brought together, and they and science are mutually benefited. The meetings of a national society, however. must be few and far between, and those who attend them, in numbers, but a feeble representation of the thousands interested in microscopy. That the concerted action of those interested in a common pursuit is necessary to their highest development, is proven by the tendency of all scientists to band together in general and special scientific societies. Microscopists must depend, therefore, upon local societies for that personal intercourse for which their scientific souls yearn.

Let us inquire into the condition of the various societies throughout the country. In the pages of THE MICROSCOPE, from month to month, are reported the proceedings of a number of societies, and these reports in several instances show a vitality and energy that are exhilarating. These are the societies recently launched upon their careers, and filled with the vigor and enthusiasm of youth, or which have been recently stimulated to renewed life by a meeting of the national society in their midst, or more rarely societies that have upon their lists of members a sufficient number of skilled microscopists to keep alive their interest. The majority of them, however, have fallen into a state of "innocuous desuetude," from which all ordinary measures seem powerless to arouse them.

Now, can we not ascertain the cause of this unfortunate state of affairs? With the cause known, can we not apply a remedy? From long continued observation of the workings of a society, which

is one of the most innocuous of its class, as one of its executive officers, we long ago saw that the trouble with our societies is the very small number of members who know even the first rudiments of microscopical science. The opportunity of studying microscopy under a competent teacher comes to but few individuals. But a small minority of the students in our universities take up the study, and even our medical colleges offer but feeble facilities for its pursuit. The difficulty is then, in short, that we lack teachers and opportunities to learn, and consequently, trained students.

The majority of the members of local societies are those who without any special training have accidentally or otherwise become interested in microscopy, bought a microscope, and have joined a society to learn how to use it. After attending a few meetings, and listening to papers on such subjects as "The Relative Value of Objectives of High and Low Angular Aperture," "The Morphology of a New Chætonotus," etc., by the learned ones of the society, they become disheartened at the array of unintelligible terms, and give it up. A few purchase elementary works, and by self-teaching obtain the rudiments of the science; but such study requires an enthusiastic student, and he too often has to unlearn much of his hard-earned knowledge. As a self-taught student we well know the rocky road he has to travel. THE MICROSCOPE has recognized this great want of teachers, and has devoted considerable of its space to the teaching of elementary microscopy, and has opened the door of its laboratory for the use of all those who may desire its facilities.

But something must be done by the societies themselves; they must be resolved to a large extent into teaching bodies, with the few skilled members acting as the tutors of the many neophytes.

We are pleased to see that at least one society — the Illinois State Microscopical Society — has formulated such a plan, with the details of execution laid out. We extract from their circular, issued to members, and we earnestly commend it to the consideration of the officers of all societies:

"The purpose in view comes from a belief that in our large city there are many young men who would be interested in microscopical study, if an opportunity were afforded them of becoming acquainted with its methods.

"At present there are here no special schools or teachers of this science. Our Society has decided to meet this want to some extent, and in several ways.

"It is proposed that all the present members of the Society invite such young men of their acquaintance to become members as may be deemed suitable, upon the inducement that they shall receive instruction at special meetings held for that purpose. At these meetings the use of new apparatus will be illustrated, methods of making the various sorts of preparations will be demonstrated, and the members will be ready to give their experience in meeting the difficulties which arise in this work.

"It is also proposed, that the new members be allotted among the older members, upon whom they may call for advice or assistance in case of difficulties arising in their work."

We further urge upon secretaries of societies to promptly report their proceedings for publication. Nothing so stimulates the work of a society as well-written and promptly-published proceedings. With these few hints acted upon, we are certain we should see a marvelous awakening in the study of our science.

A COMMUNICATION, entitled "American Microscopes — A complaint," has recently appeared in *Science*, over the signature of one of our best-known biologists and teachers. The whole article is a bitter —it seems to us—condemnation of instruments and lenses made by American manufacturers, and closes with this somewhat remarkable sentence:

"I know positively that many of the best scientific men of America are ready to join me in saying, as I said at the beginning, that there is no American microscope which we would like to buy at any price for our own use."

We regret that our space forbids us at this time taking up a detailed survey of this complaint, but in justice to American makers, instruments and objectives, we desire briefly to review some of the most prominent objections made by the writer in *Science;* and while we, perhaps, have not had the extensive experience of that gentleman, our acquaintance with the subject is sufficient to warrant us in so doing.

"The fundamental error," says this writer, "in American manufacture is that they are for the most part constructed with a view of, I might say, entrapping inexperienced purchasers," and the zeal of the maker is turned too much to "decorative laquering and nickel-plating," and a large number of mechanical contrivances are added to the stand, which increase the expense, and "are not really commendable." If this is true, it is a very serious fault, but with our

knowledge of instruments and makers, we think the writer has somewhat exaggerated the facts in the case. It is true that there are many cheap instruments — toys, which are made to attract the eye rather than to serve a useful purpose—but these microscopes are, as we have said, nothing but toys, and therefore do not come within the scope of the discussion. The *best* American microscopes are not, in our opinion, more laquered or ornamented than those of English or German make. The matter of mechanical contrivances is secondary. We hold that no incompetent person should select a microscope on his or her own responsibility, but should before purchasing submit the instrument to some one who has a knowledge of such things. If this is done, the intending buyer need invest in none of these objectionable (?) accessories and mechanical contrivances. The writer objects to the tilting stands—but the cost of such a joint is very little — and in many investigations, etc.,—other than biological and histological— to place the tube at an angle to the base is often very desirable.

We also see no reason why the writer should object to the rack and pinion coarse adjustment, since he acknowledges that the shoving of the tube up and down by the fingers is more wearing to the instrument — and it certainly is to the patience — than the former method. Again the price is called in to substantiate this complaint, but from the writer's own words he proves that the rack and pinion adjustment is economical rather than the reverse.

The stand of any microscope fitted with an Abbé condenser — and we believe that all of the leading foreign makers have adapted their best instruments to the use of this valuable accessory—must of necessity be too high for the easy manipulation of the slide while the hand rests on the table. With the low, old-fashioned Hartnach and other stands this was possible—but such instruments as these are now out of date and are rarely used except by those who cannot acquire a better and more convenient stand.

We have examined a very large line of American and foreign objectives, and feel forced to say that those of our best makes stand second to none, unless we except the lenses of one foreign make, and even these are thought to be equaled by American manufacture by many competent observers.

In THE MICROSCOPE laboratory we have American, English, German and Austrian microscopes, with objectives manufactured in each of these countries. These instruments are in daily use. Each has its defects, each its points of excellence; they are all good instruments, and with any one of them excellent biological work has been

and can be done. We do not claim that American microscopes are not without their faults; neither are foreign instruments. We object, however, to such a wholesale condemnation of home manufacture as that of the writer in *Science*, believing that it is not only unjust to American makers and misleading to purchasers, but is a serious obstacle—"a wet-blanket"—on the awakening interest shown in this country in microscopy. Nowhere in the world is the microscope used to-day as much as in this country; and to say that—because every user of a lense is not a biologist or histologist—the microscope does not instruct and refine, and in this way make better men and women, is to deny facts which are too potent to be overlooked. We have but superficially stated our belief in home instrument-makers and their desire to supply good instruments at a fair price, and we regret, as was said at the beginning,—that space forbids our entering more in detail into the further discussion of this interesting subject.

The American Postal Microscopical Club is meeting with serious difficulties in mailing its boxes—due to the new postal law. Much delay and annoyance in getting off the first installment of boxes has been experienced, and the managers have finally issued a circular to members detailing the spirit of the law, with directions in regard to mailing.

We hope that the future helpfulness of this club may not be impeded by this ridiculous postal law.

The unsightly advertisement on the last page of the index in our December number was a mistake. We attempt to remedy this, by sending in the present issue, the half page of index defaced, so that subscribers may bind up a clean volume for 1887.

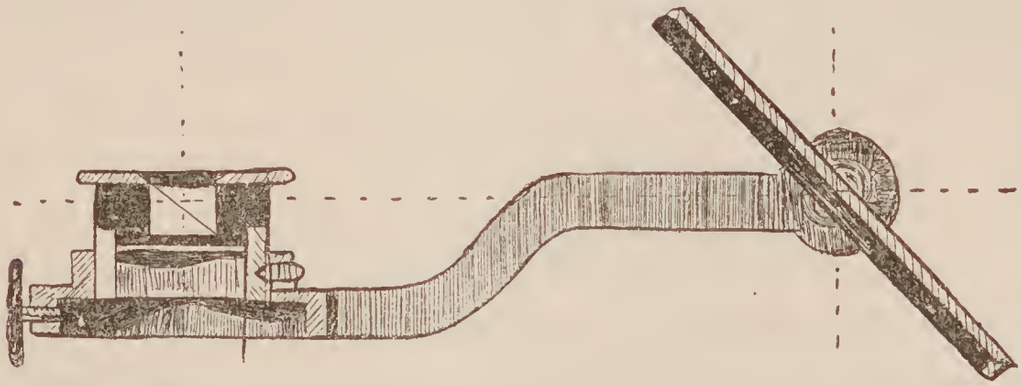
ACKNOWLEDGMENTS.—We have received from Rev. J. D. King, of Cottage City, Mass., two slides, prepared with his well-known cements. Although we have many plant-slides in our collection, these late additions are the finest that we have ever seen. We are glad to announce that Mr. King will tell in the pages of THE MICROSCOPE, how he makes these wonderfully beautiful preparations of ferns. The work done by Miss M. A. Booth has already been favorably noticed in these pages. We are glad to notice that women are not leaving microscopy entirely to the men, and if the mounts prepared by Miss Booth are a fair sample of what women can do, the sterner sex will look to their laurels. The slides before us, consisting mostly of diatom mounts, would be hard to excel, and are rarely equaled in beauty of arrangement and finish.

TECHNOLOGY.

THE LATEST CAMERA LUCIDA OF ABBE.

ZEISS makes two forms of the new Abbé camera lucida. Both are constructed on the same principle, but one (No. 70) has a large mirror and a longer arm than the other (No. 69). The larger form, the one recommended by Dr. Mayer, is only made to order. The advantage of this form is that it enables one to utilize the whole field of vision without any perceptible distortion of the image, and is thus especially useful in drawing comparatively large objects with low powers. With the smaller camera (No. 69) the whole field can be projected on the drawing-paper only by giving the mirror an inclination differing so much from the angle (45°), required for accurate drawing, that the image is more or less disproportioned. The Abbé camera is superior to that of Oberhäuser in two important particulars: it gives a much larger field of vision and better light. Its construction does not admit of use with the microscope-tube in a horizontal position. This is a defect which ought to be at once corrected. The Abbé camera, especially the larger one, can be used to great advantage with the embryograph of His. It is only necessary to add to the stand a horizontal arm, to which the camera can be fastened.

The construction of the Abbé camera is illustrated in the accompanying cut.



The drawing surface is made visible by a double reflection from a large, plane mirror, and from the silvered surface of a small prism in the usual point of the eye-piece. The microscopic image is seen directly through an apparatus in the silvering of the prism. By the concentricity thus obtained of the bundle of rays reaching the eye from both the microscope and the paper, the image and pencil are seen coincidently without any straining of the eyes. With this apparatus, moreover, drawings may be executed on a horizontal sur-

face without perceptible distortion. The brightness of the paper is regulated by smoke-tinted glasses, which fit into the prism mounting. The apparatus is specially adjusted for the No. 2 Huyghenian eye-piece; mounted on this, affixed by a clamping-screw, the mirror only requires turning in the proper position, and it is then ready for use. —*Am. Naturalist.*

PREPARING TENDON-CELLS AND CELLS OF THE LOOSE SUBCUTANEOUS TISSUE. — Dr. A. Dogiel (*Anat. Anzeig.*, 11, 1887) obtained very good preparations of tendon, by placing a rat's tail in Grenacher's alum-carmine for two or three hours, or better still, for a week or even a month. The tendon bundles swell up and become transparent, and the cells appear beautifully stained. The elastic fibres stand out very clearly. The same effect may be obtained if tendon be placed in a saturated solution of potash or ammonia-alum, and afterwards stained with Grenacher's carmine, alum-logwood, hæmatoxylin, eosin, etc. Mounted in glycerine, the preparation keeps for a long time, but afterwards a slight decoloration takes place. Permanent preparations of tendon are better placed in spirit, then oil of cloves, wherein they are teased out, then dammar or balsam. For the subcutaneous tissue it is recommended to take a piece free from fat from the inguinal or abdominal region of a mammal, and having spread it out, to stain with a concentrated solution of fuchsin, diluted with an equal volume of water, and then stain under the cover-glass, where the preparation lies in half-per-cent. solution. For permanent preparations picro-carmine, glycerine. —*Jr. R. M. Society.*

ABSTRACTS.

A PARASITIC ROTIFER.

NEARLY twenty years ago, E. Ray Lankester briefly described and roughly figured a rotifer, which he found parasitic in the body-cavity of Synapta, from the island of Guernsey. Recently Dr. Zelinka has found the same form in the Adriatic, and describes it as a *Discopus synaptæ nov. gen. et sp.* According to the latter author, this is not an endo-parasite, but lives in folds of the skin of the Synapta, and from these large numbers may be taken by a pipette. The animal belongs to the *philodinidæ.* Zelinka has been able to stain and section these animals, and describes their internal structure in some detail. His conclusions are (1) that the

bilobed wheel of the *philodinidæ* can be homologized with the ciliated band of the trocho-sphere; (2) that the anterior end of the outstretched body is homologous with the "Scheitel-platte," and (3) that the brain of the rotifer arises partly from separation from the Scheitelplatte, and partly from immigration of primitively peripheral ganglion-cells.—*Am. Naturalist.*

ASIATIC CHOLERA AND BUJDWID'S NEW CHEMICAL TEST FOR ITS BACILLUS.—After the addition of five to ten per cent. of ordinary muriatic acid to a bouillon-culture of the comma-bacillus, there develops in a few moments a rose-violet color, which rapidly increases in intensity for half an hour. It then continues unchanged for several days. The reaction occurs in bouillon-cultures ten or twelve hours old, and in gelatine-cultures after twenty-four hours. Heat increases the coloring to a marked degree. Bujdwid claims that this chemical reaction is a special characteristic of the comma-bacillus of Asiatic cholera, and distinguishes it sharply from other similar forms of bacteria.—*Medical Record.*

THE TRANSFORMATION OF BARLEY IN PROCESS OF MALTING.—Frankhausen has investigated this process microscopically (*Deut. Chem. Ztg.*), and describes the consecutive stages as follows :

"The seed at first takes up a certain amount of water, when a rise in temperature takes place with absorption of oxygen and evolution of carbon dioxide, a kind of respiration setting in with a considerable increase of temperature. Simultaneously the walls of the cells containing starch are broken down, and the starch bodies are rendered friable, so that they may be crushed between the fingers; the starch granules themselves, however, undergo no further change. What breaks down the cell tissue and causes the change in the starch cannot be micro-organisms, as intimated by Ducleaux and Pasteur, since none of these could be found, but the author discovered that besides carbonic acid, strange organic acids were formed, and that by treating malt with an alkali considerable formic acid was produced. This acid, as was found by experiment, converts starch into glucose, similarly to sulphuric acid, and also dissolves the cell tissue, which, though consisting of cellulose, more difficultly soluble than starch, yet are permeated by the acid, owing to the distribution of starch over the whole structure. In practice, for this reason, in malting the process is interrupted when the tissues are dissolved, in order that the formic acid produced may be sufficient to transform the starch into sugar."—*Western Druggist.*

NEWS AND NOTES.

M. PASTEUR is said to be in such feeble health as necessitates his confinement to the house.

CHANGE OF ADDRESS.—Dr. James E. Reeves, formerly of Wheeling, W. Va., has removed to Chattanooga, Tenn.

PROF. BESSEY adds the winged pig-weed (*Cycloloma platyphyllum*) to the list of so-called "tumble-weeds."

MR. NICHOLAS PIKE has recently prepared a list of the marine algæ collected from the shores of Staten Island.

THE *Jahresbericht*, edited by Baumgarten, for the year 1886, contains abstracts of 533 papers relating to micro-organism.

THE death is announced, Nov. 6th, of Mr. Oscar Harger, who was long an assistant under Prof. O. C. Marsh, at Yale College.

VON LENDENFELD publishes in the *Proc. Zool. Soc.*, London, 1886, a paper on the "Systematic Position and Classification of Sponges."

AT a recent meeting of the Boston Society of Natural History, Dr. Walter J. Fewkes read a paper on "A New Mode of Life among Medusæ."

DR. C. O. WHITMAN, in the *American Naturalist*, suggests the word *planisher* as a substitute for the compound and clumsy word section-flattened, or section-smoothed.

ANOTHER titled scientist is added to the list. The Emperor of Austria has conferred upon M. Pasteur the decoration of the order of the Iron Crown, with the title of Baron.

THE history of garden vegetables, by Dr. E. Lewis Sturtevant, now running, in the *American Naturalist*, is a valuable contribution to vegetable gardening. We hope to see it later in book form.

DR. HENEAGE GIBBES, of London, Eng., has been called to the Chair to Pathology in the Medical Department of the University of Michigan. Dr. Gibbes is a well-known histologist and bacteriologist.

AN important paper by Voglino, on the *agaricini*, appeared in the July *Nuovo Giornale Botanico Italiano*. Microscopical measurements and descriptions of the spores, basidia and sterigmata are given.

MR. JOHN A. BRASHEAR, of Allegheny, Pa., gave a reception recently at his works, to afford those interested an opportunity to examine the large Star spectroscope designed and constructed for the Lick Observatory, at Mt. Hamilton, California.

DR. JAMES REEVES recently cut 1,259 serial sections from a human embryo, five-eighths of an inch long; 1,252 of these sections were mounted on seventy-six slides. They are now in the possession of the Jefferson Medical College Museum, Philadelphia.

THE NORTHWESTERN UNIVERSITY of Chicago has recently purchased one of Prof. W. A. Rogers' comparators, with universal end-measure and coefficient of expansion attachments, etc. This instrument is in the private laboratory of Prof. Ewell, at Evanston, Ill.

CLARENCE M. WEED, in the *American Naturalist*, states that the genital organs of the *Phalangiinæ* are best exposed if the caudal portion of the abdomen be compressed between the thumb and finger. The organs are thus pushed out of the genital opening between the coxæ, and if the specimen is immediately dropped in alcohol, will generally remain exposed.

HELMHOLTZ dates his start in science to an attack of typhoid fever. This illness led to his acquisition of a microscope, which he was enabled to purchase owing to his having spent the autumn vacation of 1841 in the hospital, prostrated by typhoid fever ; being a pupil, he was nursed without expense, and on his recovery he found himself in possession of the savings of his small resources.—*Sir John Lubbock.*

BOOK REVIEWS.

A TEXT-BOOK ON SURGERY, GENERAL, OPERATIVE AND MECHANICAL, by John A. Wyeth, M. D., Professor of Surgery, New York Polyclinic, etc. New York: D. Appleton & Co. 1887. Royal octavo, pp. 777.

The above work of Professor Wyeth will be received with open arms by the profession of America. Although the exhaustive treatises of Gross and Agnew and the great International Encyclopædia are unequaled in their field, an American surgeon has not in recent years produced a thoroughly popular text-book. This is confirmed by the large circulation of Bryant, Erichsen, and other foreign works. Again, because of the great change that operative surgery and surgical therapeutics have undergone by the introduction of antiseptic methods, a work on surgery written three or four years ago is useless as a text-book.

The experimental period of antiseptic surgery has, however, passed, and the writer of to-day can lay down the truths of antisepsis and the rules for obtaining it, with the assurance that they will be but slightly, if at all, modified for many years to come. Scattered through our journal literature of the last few years, and in recent

books and monographs, are traced the steps in the development of antiseptic technique, of dressings and ligatures; but it has not as yet found its way in its fully perfected state into the text-books of general surgery. The times then are ripe for the cordial reception of an American work that brings the art and science of surgery to the present date. That Dr. Wyeth's is the coming text-book we firmly believe.

We turn at once to the subject of antiseptic surgery, very properly given the first chapter in the book, and find in eight pages a concise but complete account of dressings and their preparation, and a few pages on the details of an aseptic operation. With aseptic surgery made so plain and in so short a lesson, the surgeon who, through ignorance or prejudice, does not give his patients the comfort and safety of it, commits an offense that should not be condoned.

Professor Wyeth's reputation in the field of the surgery of the arteries impels us to read carefully the chapters on this subject: they contain his large experience crystallized. The newly-developed field of the surgery of the great cavities of the body receives the full attention its importance demands. Our short space, however, forbids a further detailed review. But it is almost unnecessary—we could not say aught but in praise. The book presents the broad field of general surgery in a concise style that is refreshing; theoretical discussions are omitted, and what the author thinks to be the best modes of treatment only are given, and this, with its generous illustrations, make it a perfect book for ready reference. The printing and binding are in the highest style of the art.

FRESH WATER SPONGES: A MONOGRAPH, by Edward Potts; including Diagnosis of European Spongillidæ, by Prof. Franz Vejdovsky (Prague). Philadelphia: Academy of Natural Sciences. 1887. Octavo, pp. 279, paper.

Since the publication of "The History and Classification of the Known Species of Spongilla," by H. J. Carter, F. R. S., in 1881, many genera and species have been discovered, especially in North America. The object of the author of the very exhaustive monograph before us is to describe these genera and species, to give to the scientific world the results of his observations into the character and variations in North America of all known species, and by adding brief technical descriptions to make it a complete work for reference.

In the introduction we find a succinct account of the morphology of the sponges, illustrated by excellent plates from drawings by Dr. C. W. de Lennoy and Miss S. G. Foulke of Philadelphia; and the methods of collecting and mounting.

Following this is the diagnosis of the European Spongillidæ, translated from the Bohemian of Professor Vejdovsky; and then comes a complete description of American species. We note numerous references to the many discoveries and excellent work in this field of our esteemed contributor, Mr. H. Mills, of Buffalo.

In the preparation of this work, the author has shown the spirit of the scientist in its highest sense. He has snatched minutes, or a few hours, from the time of a very busy life and devoted it to his favorite study with no hope of reward, save in his own satisfaction and the praise from the scientific world which is so sure to follow.

LIVING LIGHTS: A POPULAR ACCOUNT OF PHOSPHORESCENT ANIMALS AND VEGETABLES, by Charles Frederick Holder. New York: Charles Scribner's Sons, pp. 187.

The object of this work is to create an interest for natural history in the young. The method adopted by the writer to bring this about is certainly the correct one. He has appealed to the marvelous in nature, and while many of his descriptions have the absorbing interest of the fairy tale, they possess the merit of absolute accuracy. And, what is more, the interest thus aroused will impel the youth of any parts at all to continue his investigations still further, even though they may lead him to somewhat dry details. The illustrations are in harmony with the text, and even grown-up people cannot fail to linger over them. Works of this kind are entitled to much of the field now occupied by the Oliver Optics, and we wish there were more of them.

NATURAL LAW IN THE BUSINESS WORLD, by Henry Wood, Esq. Boston: Lee & Shepard. New York: Charles T. Dillingham. Paper, pp. 222.

This work, which has already achieved a large circulation, certainly deserves to be still more widely read. The questions discussed are not approached in a fanciful or theoretical way, but are treated in an eminently practical manner. The natural laws which govern human relations are as incontrovertible as those of gravitation. Mr. Wood has attempted, and with much success, to explain and make these laws more prominent, which, if heeded, would do much to neutralize the harmful theories so prevalent at the present time. It is a strong book and capable of much good.

THE AMERICAN PRINTER: A MANUAL OF TYPOGRAPHY, ETC., ETC., by Thomas MacKellar, Ph. D. Philadelphia: The MacKellar, Smith & Jordan Co., pp. 383.

This book, now in its sixteenth edition, is too well known to need recommendation. The rise and progress of printing, and all the departments of the art, are clearly and concisely treated, making

the work of the greatest value and importance to the practical printer, and a handy reference-book for the publisher's desk. The present edition, while essentially like the last, has some important changes and additions. We consider it the best book published for printers.

THE STUDENT'S HANDBOOK TO THE MICROSCOPE: A PRACTICAL GUIDE TO ITS SELECTION AND MANAGEMENT, by A Quekett Club man. London: Roper & Drowley, Ludgate Hill, E. C., 1887. Pp. 68.

This work is very elementary in character and is confined almost exclusively to descriptions of the various English microscopes and accessories. They who have never seen a microscope and desire to purchase one will find this work of assistance in selecting an instrument of English make—for no others are described. We think the writer has made a mistake in limiting his descriptions to English manufactures, for, as the work now stands, it is far from complete. The book is profusely illustrated.

THE PHYSICIAN'S PERFECT CALL-BOOK AND RECORD. By Dr. G. Archie Stockwell, F. Z. S. George S. Davis: Detroit, Mich.

Although this record is admirably arranged for the purpose intended, we cannot see that it contains anything especially different to place its usefulness above older publications of the sort. It is issued in elegant form.

CALENDER OF THE UNIVERSITY OF TORONTO, 1887-88.

MICROSCOPY: REPRINTS FROM AM. NATURALIST, from Dr. C. O. Whitman.

ABSTRACT OF PROCEEDINGS; MICHIGAN STATE BOARD OF HEALTH, Oct. 11, 1887.

PARASITIC FUNGI OF ILLINOIS. Part II. By T. J. Burrill and F. S. Earle. 1887.

THE INDEBTEDNESS OF PHOTOGRAPHY TO MICROSCOPY, by A. Clifford Mercer, M. D. Reprint.

OVARIAN TUMORS, AND REMARKS ON ABDOMINAL SURGERY, by Edward Borck, A. M., M. D. Reprint.

NECESSITY FOR TEACHING HYGIENE IN SCHOOLS. By W. C. Cook, M. D., Health Officer, Nashville, Tenn.

BULLETIN OF THE ILLINOIS STATE LABORATORY OF NATURAL HISTORY, Champaign, Ill. Vol. II., Article VI.

FORCED RESPIRATION IN OPIUM POISONING, ETC., by Geo. E. Fell, M. D., F. R. M. S. Buffalo *Med. and Surg. Journal*, Nov., 1887.

TRANSACTIONS OF THE INDIANA STATE DENTAL ASSOCIATION. 1887. Indianapolis, Ind. Published for the Association by Mrs. W. M. Herriott.

CONTRIBUTIONS TO GYNECOLOGY, FASCICULUS I. THE GALVANIC TREATMENT OF UTERINE FIBROIDS. FULL TEXT OF FIRST FIFTY CASES. By Ephraim Cutter, A. M., M. D., LL. D.

CORRESPONDENCE AND QUERIES.

DETROIT, NOV. 1887.

To the Editors of the Microscope:

In attempting to follow the method of preparing, cutting and mounting pathological specimens described in Dr. James E. Reeves' book, I had a very serious run of failures, but have at last reached what I consider grand success. I now have no difficulty in cutting sections of tumor $\frac{1}{400}$ inch in thickness; have just cut twenty-five of such without a miss, and I presume I could cut one or two hundred without a break—(this specimen was ready for cutting in three days after its removal from the patient).

Only about one-half or one-third of these very thin sections come from under the section-flattener in condition to mount. For use *in place of balsam*, Berry Bros.' oil finish, which is more elastic than their hard finish, and dries quickly.

In cutting sections $\frac{1}{200}$ inch in thickness (two clicks of the large B. & L. microtome) every one comes out straight enough for mounting.

Thinking that it may benefit others, I will point out the causes of my early failures.

The chief trouble came from using the best paraffin that could be found in this city.

After trying many samples, and being uncertain as to whether the trouble was want of skill or inferior material, I found that no paraffin sufficiently hard for this purpose is used in drug stores here, hence it is not kept in our wholesale stores.

I finally obtained from the Standard Oil Co., at Cleveland, a specimen of their hardest refined paraffin, which filled the want, and enabled me to cut the thin sections mentioned.

A slightly softer paraffin may be necessary in very cold weather.

The next difficulty was in finding a cloudiness in the mounted specimens, and this, too, after a liberal use of absolute alcohol on the sections. Dr. Reeves told us that the cloudiness did not come from water, as supposed, but from the paraffin, through insufficient time in the spirits-of-turpentine bath. Since this correction I have had no trouble with either cutting or mounting.

I am delighted with the method.

R. N. REYNOLDS.

EXCHANGES.

This department is for the benefit of SUBSCRIBERS *who have microscopical apparatus, material or books which they wish to exchange, and such wants will be* INSERTED FREE OF CHARGE. *The number of insertions given will depend upon the number of exchanges received each month. Subscribers will please notify us when articles have been exchanged or sold. Dealers are referred to our advertising department.*

WANTED TO PURCHASE—*American Journal of Microscopy*, Vol. I, 1876, Nos. 1 and 8; Vol. III, 1877, No. 2; Vol. IV, 1879, Nos. 3, 5 and 6; Vol. V, 1880, No. 7; Vol. VI, 1881, No. 5; *American Monthly Microscopical Journal*, Vol. I, 1880, Nos. 5, 7, 9 and 11; Vol. II, 1881, Nos. 1, 8, 9, 10, 11 and 12; Vol. VI, 1885, No. 10; Vol. VII, 1886, No. 11; *American Quarterly Microscopical Journal*, Vol. I, 1879, Nos. 1, 2, 3 and 4; THE MICROSCOPE, Vol. I, 1881, complete. Address C. C. MELLOR, 77 Fifth Ave., Pittsburgh, Pa.

MOUNTS OF FŒTAL (5 MONTHS) LUNG, section across entire lobe, 1-2000 in. thick, beautifully stained, in exchange for first-class Pathological Slides.
W. C. BORDEN, M. D., U. S. A., Fort Douglas, Utah.

HISTOLOGICAL, PATHOLOGICAL AND MISCELLANEOUS MOUNTS for exchange by H. W. WESTOVER, M. D., St. Joseph, Mo.

TUBES OF CLEANED DIATOMS, in exchange for mounted slides or good material. For list, etc., address A. B. AUBERT, Orono, Penobscot Co., Maine.

FOR EXCHANGE.—Slides of vegetable and animal sections, all double-stained, new process, for hair of full-blooded Indian, elephant's beard and tail, trichina meat, and well-mounted slides. J. D. BECK, 305 Church St., Williamsport, Pa.

FOR EXCHANGE.—One dozen well-mounted histological and pathological sections. Will exchange for some recent-edition book on histology or pathology. Address
L. G. WILLE, Avoyelles Parish, Marksville, La.

MOUNTS OF SALICINE, PURE UREA, AND OTHER CRYSTALS, by an entirely new process, and the most beautiful ever seen, in exchange for strictly first-class pathological slides only, or for sale. FRANK L. JAMES, M.D., Box 568, St. Louis, Mo.

WANTED—A microscopical slide cabinet containing about one thousand objects. Must be in good condition. Send description, price, etc., to
JAMES B. SHEARER, Bay City, Mich.

GOOD histological or pathological mounts for other first-class mounts.
S. G. SHANKS, M. D., 547 Clinton Ave., Albany, N. Y.

FOR SALE—Beck Popular Binocular with complete outfit, 2-in., 1-in. and ¼ ob. polariscope, parabola, double nose-piece, 3 sets eye-pieces, etc., in perfect order, only tarnished. Price, $80. Address WM. H. SEAMAN, Patent Office, Washington, D. C.

WANTED—B. eye-piece (to fit Bausch & Lomb's smaller stands), a camera lucida, a stage micrometer (metric preferred) and a good turn-table; also Carpenter, or Beale, on the Microscope. Will exchange for above, books on Mineralogy and Chemistry and general literary works. Correspondence solicited. A. F. BARNARD, Box 152, Oberlin, O.

EXCHANGE.—I have well-mounted slides of diatoms, also diatomaceous material which I offer for curiosities or materials suitable for a cabinet.
F. L. CAUCH, Carpentaria, Santa Barbara Co., Cal.

LABELS for slides; also, slides and material.
EUGENE PINCKNEY, Dixon, Ill.

EXCHANGE.—Will exchange slides of vegetable sections, double-stained, for other *good* slides, preferably of the same nature.
CHAS. E. BARR, 301 Clinton St., Cleveland, O.

WANTED—Standard books on Rotifera, Infusoria, Diatoms, Algæ, etc. Will exchange general and scientific works for the above.
JAMES E. WHITNEY, Rochester, N. Y.

FOR EXCHANGE.—I have for exchange for mounted slides specimens of crystallized quartz, microscopic and small, perfect crystals, crystals from one-half to three inches in diameter, crystals containing floating particles, crystals containing cavities, and some containing hornblende. State which you prefer, and I will endeavor to give satisfaction.
D. M. FULLER, 154 Hamilton St., Albany, N. Y.

THE MICROSCOPE.

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Subscriptions, Advertisements and all business matters are attended to by THE MICROSCOPE PUBLISHING CO., 25 Washington Avenue, Detroit, Mich.

No receipt will be sent for subscriptions received unless specially requested.

Specimens for examination should be sent to the *Microscope Laboratory*, 25 Washington Avenue, Detroit, Mich. In all cases the transportation charges on these specimens must be prepaid, and special directions for packing and shipping will gladly be sent upon application.

VOL. VIII. DETROIT, FEBRUARY, 1888. No. 2

ORIGINAL COMMUNICATIONS.

NOTES ON TWO PRESUMABLY UNDESCRIBED AQUATIC WORMS.

DR. ALFRED C. STOKES.

PLATE II.

I.

THE aquatic worms of this country form a large group of animals demanding the use of the microscope for the elucidation of their structure; yet, although they are abundant and attractive, they have received but little attention. Those extremely interesting annelida which are classed together under the suborder Oligochæta have been studied by a still more limited number. Dr. Joseph Leidy has increased our knowledge of certain genera and species, and Dr. Gustaf Eisen has been a careful and successful investigator, describing several wonderful and previously unknown forms, notably the type of a new family group (Eclipidrilidæ), the worm having its habitat in the high Sierra Nevada of California, at an altitude of ten thousand feet or more. In reference to the detailed anatomy and histology of any Oligochæte, I am acquainted with but one paper, that on *Aulophorus vagus*, Leidy., published in the *Proceedings of the American Academy of Arts and Sciences* for October, 1884, by Mr. Jacob Reighard. Further than this little has been done. The field is, therefore, almost entirely uncultivated, and, presenting, as it does, an almost undisturbed surface, it awaits the coming of the scientific investigator, being ready to respond to his slightest touch, and to reward him most abundantly for a little patient attention.

To properly investigate these aquatic creatures, the microscopist should be able to successfully use the microtome. The worms are, as a rule, transparent, but the attempt to study the various parts and organs through the tegumentary coat of the living, writhing animal is somewhat difficult, and apt to be followed by errors of interpretation. The histology of the various parts can be satisfactorily investigated only by means of stained and serial sections, but microtome work over creatures whose bodies are visible to the naked eye chiefly by reason of their length and not on account of their size in other directions, is work for the expert. And here is an obstacle. It is not every microscopical student, working alone, who can possess the instrument needed for such delicate cutting, and he has consequently not acquired the skill necessary, not only for the manipulation of the microtome, but for the preliminary treatment of the specimens. This is the writer's unfortunate situation, although he has been so highly favored as to obtain the assistance of an expert microtomist, who will take one of the subjects of this paper, and prepare it for future study, the results of which will be embodied in another essay supplementary to the present one. The following description, therefore, of some points in the anatomy of two presumably undescribed aquatic worms is superficial, but it is the result of prolonged and repeated study of the living creatures.

II.

ÆOLOSOMA DISTICHUM, SP. NOV. (FIG. 1.)

For three years past the writer has been finding the worms here referred to, often in great profusion. They appear to favor the depth of stale or even partially decayed collections of aquatic plants left standing in the light and warmth of a room, occasionally presenting themselves in abundance in such places. I have no recollection of capturing any from an open pond or pool. They were first obtained among a decaying mass of *Sphagnum*, which had been gathered several months before and had remained in a covered vessel until the water was thickly coated with a slimy mass of microscopic fungi, on the surface of which the worms glided in great numbers, and where they seemed to find a plentiful supply of food. More recently they have developed in such quantities in an old infusion of dead autumn leaves that the small and almost filiform bodies became conspicuous by reason of their numbers. In a vessel containing decaying *Lemna*, *Myriophyllum* and other aquatic plants they have appeared suddenly and plentifully. In a similar mass of decaying vegetation originally brought from the cypress swamps of Southern Florida,

they have also become developed, and finally they have appeared in a small collection of *Lemna*, sent to the writer for another purpose by Mr. H. E. Valentine, of Boston, and left standing on the table for several weeks. They therefore seem to prefer the proximity of decaying vegetation, and their habitat appears to be in favorable situations along the entire Eastern coast, south of and including Massachusetts.

The food consists chiefly of the softened and decaying leaflets and other parts of the plants, together with the fine, granular debris which collects at the bottom of the water. These matters are seized by a snapping motion of the mouth and lower lip. Animal food appears to be taken by accident only; it consists chiefly of Rhizopods.

The only American species of *Æolosoma*, with the exception of the one here referred to, was discovered by Dr. Joseph Leidy, and was described by him in the *Journal of the Academy of Natural Sciences, of Philadelphia*, II, 2, November, 1850.* He named it *Æolosoma venustum*, having obtained it among Confervæ, upon which it feeds, in fresh water ditches near Philadelphia. Upon the present form I propose to bestow the specific name *distichum.*

Two characteristics of the genus *Æolosoma* are the absence of the podal spines, so common in certain Oligochæta, and the presence of numerous, scattered, bright red spots which, at first glance, appear to be superficial, but are, on the contrary, embedded within the tegument. In *Æ. venustum*, Dr. Leidy states that "the red globules variegating the posterior part of the body appear to be colored nuclei in the muscular bands of the tegument." The same appearance obtains with the entire body of *Æ. distichum*, where, in some instances, the transverse muscular bands become very distinct, and the red spots correspondingly conspicuous.

The body is colorless, depressed, broad, changeable in form, and attractively variegated by these large, irregular, red spots distinctive of the genus. The articulations vary in number from eight to twelve, all of which, except the first, or oral one, are furnished with apparently four fascicles of bristles, two on each side (one dorso-lateral and one ventro-lateral), but this arrangement is apparent only. The two fascicles on each setigerous segment, (one on each side) are divided into two somewhat widely separated parts, each articulation therefore, except the first, seeming to have four fascicles

*Since this was written Prof. F. W. Cragin has described two additional forms from Kansas, naming them *Æ. Leidyi* and *Æ. Stokesii* respectively. (*Bul. Washburn College Laboratory*, II. 2, Oct. 1887.)

of setæ instead of the usual two. Each of the two parts of the compound cluster is composed of from four to eight simple bristles of unequal length, each entire compound fascicle being consequently formed of from eight to sixteen setæ, or of from two or four short bristles intercalated between two or four long setæ in each secondary cluster. The long setæ usually exceed in length the breadth of the extended body, while the shorter ones are about one-half that length, stouter, and gently curved at the distal extremities. None are furcate. Each of the two parts composing each compound fascicle has several (four or more) muscular threads which are independent of those of the other secondary cluster, but both are connected by a large and apparently strong muscle passing transversely from one secondary bristle-sac to the other. As a rule there are four long and four short setæ in each of the separated parts.

The oral segment is produced anteriorly as a large lip, which is subcircular in outline, and soft and changeable in form. Its entire lower surface is clothed with fine vibratile cilia. In *Æ. venustum*, Leidy states that the cilia fringe the edges of the hexagonal cells composing the under surface of the lip, but such an arrangement does not obtain with the present species, the whole surface of the part being evenly clothed with the fibrillæ.

The anal segment is somewhat narrower than the other articulations, obtusely rounded at the extremity, which is centrally emarginate. Its posterior border, as well as the anterior margin of the upper lip, is hispid with fine, short hairs. The general body surface bears many similar short, scattered setæ.

The mouth is surrounded laterally and posteriorly by a thick, muscular lip, shaped somewhat like the letter U, the arms extended forwards. It is strongly ciliated and opens into a short but capacious pharyngeal passage, which, at the second articulation, contracts and is continued as a narrow, often tortuous, œsophagus, which extends through the second segment to about the middle of the third, where it dilates into the digestive cavity proper. The latter is broadest centrally, and extends to near the sixth segment, when it gradually narrows and is continued posteriorly to the terminal anal aperture. The walls are thick, and the internal surface of the entire alimentary canal is ciliated, the cilia of the rectum being large and powerful, producing a strong current, and often rotating the excrementitious mass before it is expelled. They frequently project as a small cluster beyond the anal aperture. The cilia of the remaining surfaces are fine and short.

The tortuous segmental organs are a single pair in each segment except the oral, and perhaps the anal. They open externally by a minute pore near the centre of the ventral surface, and close to the median line of the body. The tubules are intimately adherent to each other, forming a flattened cluster, one margin of which is usually attached to the body wall, the rest of the organ floating freely within the body cavity. A long duct connects each with the side of the intestinal canal, and opens by an external orifice as already indicated. The tubules do not originate by a dilated, funnel-like orifice, but by a slightly expanded opening whose aperture, and the external walls for a short distance, are clothed with long, fine cilia (Fig. 2).

Mr. E. C. Bousfield (*Journal Linnæan Society of London*, xx, 1887) "regards the segmental organ as purely mechanical in function, 'in preventing undue distention of the body by the fluid which passes through the walls of the intestine, and is doubtless charged with effete material from the blood-vessels which run in contact with it.' Moreover, what is generally considered to be the movement of cilia in these organs he maintains to be due to the vibration of a membrane, the free edge of which can be seen when vitality is at a low ebb. Observations on *Tubifex*, *Nais*, *Stylaria*, and *Æolosoma* lead him to this view."* That the vibratory appearance within the tubules is due to an undulating membrane is not correct so far as the present species of *Æolosoma* is concerned. Not only are the internal walls ciliated, but the cilia project beyond and around the free extremity and, in some instances, extend for a short distance down the external surface.

The dorsal vessel, at its anterior portion contracts vigorously. Near the posterior region of the digestive enlargement of the alimentary canal it divides into several ramifications which extend over the surface of the part, and presumably reunite anteriorly to form the single vessel there conspicuously visible. At the posterior border of the pharynx the dorsal vessel gives off two lateral branches which extend around and below the pharyngeal passage, and unite to form the single ventral vessel, while the main trunk continues forward to beyond the mouth where it furcates into a right and left hand branch, each of which passes downward and backward to join the ventral portions of the pharyngeal vessels. This is at least my interpretation of the appearances. As the blood is so nearly colorless, and the dorsal vessel is clearly visible only during its expan-

* *Jour. Royal Micros. Soc.*, October, 1887.

sion, the points at which the anterior branches enter the ventral part of the pharyngeal vessels may have been misinterpreted. The apparent arrangement is shown in the diagram (Fig. 3).

The fluid of the body cavity seldom contains those freely floating, granular corpuscles often so abundant within the body of other aquatic worms.

The nervous system can be studied satisfactorily only after sectioning and staining. This must, therefore, be postponed.

The worm's swimming movements are not performed by the lateral undulations of the body so common with *Pristina*, *Nais*, and other Oligochæta. The labial cilia are here the chief organs of natation, and by their aid the worm advances evenly and smoothly through the water.

Although very many individuals have been examined, none have been found sexually mature. The only form of reproduction observed is by transverse fission, which takes place rapidly, a single individual not rarely presenting evidences of two reproductive divisions.

In length the extended body may reach $\frac{4}{10}$ inch. The smallest forms observed measured only about $\frac{1}{24}$ inch in length.

III.

PRISTINA FLAVIFRONS, SP. NOV.

The body is for the most part colorless, or very pale brownish, depressed sub-cylindrical, the articulations, of which there are from thirty-seven to sixty-three, being quite uniform in width except near the two extremities. The posterior or anal segment is narrowed, tapering, and terminated by two rounded papillæ, one on each side of the anal aperture. These are hispid with short, stiff hairs (Fig. 4), as also is the entire body, but sparingly so, the short setæ being widely separated.

The upper lip terminating the anterior extremity is somewhat widened, and the pharyngeal segments immediately behind it are slightly constricted. The lip is itself formed of a conspicuous, rounded lobe on each side, with a deep depression separating them (Fig. 5), the long, soft and flexible proboscidiform process springing from this central concavity, the entire region being hispid with many short, stiff hairs. The lip measures from $\frac{1}{200}$ to $\frac{1}{120}$ inch in length from the mouth, and, when the worm is observed in profile, the part seems to be depressed, rounded inferiorly, and slightly curved upward so that it has, in longitudinal optic section, a concavo-convex

outline (Fig. 6). The proboscis-like organ varies in length from $\frac{1}{37}$ to $\frac{1}{24}$ inch from the distal extremity of the lip, its length seeming to depend upon the size of the worm that bears it. It is thick-walled and hollow, and communicates with the body cavity.

The two eyes are placed on the oral segment, one at each angle of the mouth, on the ventro-lateral border. The mouth is large, and, when expanded, is round, at other times showing itself as a transverse, irregularly slit-like fissure.

Every articulation, except the first, is supplied on the ventral surface with two fascicles of podal stylets, with from three to seven stylets in each cluster. In the posterior segments these appendages become successively smaller and more rudimentary, until the anal articulation usually has only a trace of a few short spines, or often none. There is no invariable rule as to the number of stylets in each fascicle, the cluster on one side often differing in number from the one on the opposite border of the same segment. Frequently there are only three; more than seven I have never seen in one fascicle. In form they are long sigmoid, terminating in a double unguis, one limb of the hook being very small and inconspicuous. The inner or attached end of the stylet is angularly bent and conically tapering, the rounded enlargement common to the podal spines of so many aquatic worms here usually being absent, or represented by a very inconspicuous swelling at the first angle. In length the stylets measure from $\frac{1}{182}$ to $\frac{1}{167}$ inch. One spine is shown much enlarged in Fig. 7.

Beginning at the sixth articulation, and continued to near the posterior extremity, the segments have on both sides a single dorso-lateral bristle, usually accompanied by one or more short, straight, rudimentary hairs, the former measuring from $\frac{1}{75}$ to $\frac{1}{50}$ inch in length, except on the extreme posterior articulations where they become mere rudiments. There are none on the oral or pharyngeal segments in front of the sixth body-ring. They frequently vary in length on opposite sides, the short bristles being, as I suppose, newly produced and in process of growth to supply the place of the fully developed setæ that have been lost. Indeed, they seem to leave the body with great facility, as they often fall away while the worm is under the microscope, and specimens are not rarely taken with the central part of the body entirely free of all appendages except the podal stylets. But beginning at about the twentieth segment from the posterior extremity, the bristles gradually and regularly decrease in length (Fig. 4), until the anal articulation is reached,

when they have become mere rudiments, $\frac{1}{400}$ inch or less in length, the articulations posterior to this point bearing rudimentary podal stylets only. This arrangement of the bristles gives the worm an attractive and unique appearance, when present in the beautiful regularity often to be observed. Occasionally, especially in the largest and presumably oldest worms, the symmetrical arrangement is interrupted by the interposition of one or more extremely long bristles.

The intestinal canal is capacious, brown in color, moderately tortuous, and distinctly divided into pharynx, œsophagus and intestine. The pharynx extends from the mouth to the beginning of the sixth articulation. It is protrusible, the worm thrusting it out in order to seize the vegetable particles and diatoms on which it feeds, and at times using it as a sucker to assist in progression. The upper surface of the passage is ciliated, and one characteristic feature, the one that has suggested the specific name, is the lemon-yellow color which tinges the whole organ, and extends to the beginning of the œsophagus, where it abruptly ceases. It extends into the upper lip where it is most distinct near the lateral margins. In both these parts the color often deepens to an orange hue.

At the beginning of the sixth articulation the pharynx is contracted and becomes the œsophagus, which occupies only the sixth and seventh segments. In the eighth the passage suddenly dilates into a sub-cordiform or sub-spheroidal sac, the intestine again narrowing in the ninth, while in the tenth and eleventh it again forms an obovate enlargement, contracting near the beginning of the eleventh, and thence continuing tortuously to the anal aperture. The portion of the canal passing through the fifteen or sixteen posterior articulations is ciliated.

From the beginning of the œsophagus at the sixth segment to within five or six articulations of the posterior extremity, often as far as the anal segment, the tubular passage is abundantly supplied with small, golden-brown granules or refractive oil drops, probably representing an hepatic organ, or being cells having an hepatic function. They are densely aggregated over the intestine near each membranous dissepiment, the tube appearing to be transversely striated by very dark, narrow bands.

Segmental organs, apparently ciliated, are present on each side of most of the articulations.

The worm measures from $\frac{3}{10}$ to $\frac{4}{10}$ inch in length; in greatest width $\frac{1}{100}$ inch. It has been obtained in abundance on the lower

PLATE II.

surface of *Lemna polyrrhiza*, and among the leaflets of *Myriophyllum*. None have been found sexually mature, reproduction being ordinarily by transverse fission.

EXPLANATION OF THE PLATE.

Fig. 1. *Æolosoma distichum, sp. nov.*

Fig. 2. *Æolosoma distichum*, termination of segmental organ; diagram.

Fig. 3. *Æolosoma distichum*, blood vessels of the head; diagram.

Fig. 4. *Pristina flavifrons*, posterior extremity.

Fig. 5. *Pristina flavifrons*, anterior extremity; ventral view.

Fig. 6. *Pristina flavifrons*, anterior extremity; profile.

Fig. 7. *Pristina flavifrons*, podal stylet.

TRENTON, NEW JERSEY.

THE SPECTROSCOPE AND ITS APPLICATION TO MEDICAL PRACTICE.*

DR. S. WATERMAN.

THE telescope, the microscope, and the spectroscope are three great lights to aid man in scientific investigations. The telescope has conquered space, and revealed to us the beauty and grandeur of the starry heavens; the microscope has made us acquainted with a new world, with a miniature creation, invisible to our unaided vision, a world so full of beauties and enchanting sights, and of the greatest usefulness to unravel the structure of organic and inorganic matter. The spectroscope, with its analytical prisms, has revealed to us the composition of celestial worlds, as well as the chemistry of terrestial matter. We may leave the astronomer to sweep the infinite realm of space for new wonders and new discoveries; enthusiastic votaries penetrate the infinitesimal world with their powerful microscopes, in which department it reigns supreme. To describe the spectroscope, its wonderful analytical powers, its conquest in celestial and terrestial chemistry, this, it shall be my task to lay before your kind consideration; in rendering an account of the spectroscope, and its applicability to medicine, we enter a field of inquiry, whose limits have not yet been reached, nor its depth and breadth fully explored.

It is not claimed that the spectral, or prismatic test is destined to supersede other modes of procedures hitherto employed by the

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analytical chemist. It cannot displace the microscope nor any of the other appliances, which have until the present day constituted the armamentarium of a chemical laboratory. But it can be justly claimed that we possess in the spectroscope a new power of the first magnitude. The precision and exactitude with which it analyzes organic as well as inorganic substances challenges our highest admiration. It distinctly and instantaneously reacts to most infinitesimal particles of matter, vapors and gases, so that five new metals have been discovered by its aid which perhaps might have remained unknown forever.

Says Professor Roscoe, in his splendid work on spectrum analysis: "We are forced to admit that by the application of the simple principle of spectrum analysis the chemist is able to overstep the narrow bounds of our planet, and, extending his intellectual powers into almost illimitable space, to determine with as great a degree of certainty as appertains to any conclusion in physical science, the composition of the atmosphere of the sun and far-distant fixed stars. Nay, he has even succeeded in penetrating into the nature of those mysteries of astronomy, the Nebulæ, and has ascertained not only the chemical composition, but likewise the physical condition of those most distant bodies."

And what immense amount of valuable material has been harvested from the domain of organic and animal chemistry! The flood of light which it has thrown upon vital processes, the nature and function of the blood, how it has amplified our knowledge of the wonderful processes of respiratory, oxidising and oxygenating powers of this vital fluid, its natural affinities for oxygen and carbonic acid, its energetic and dangerous affinity for poisonous irrespirable gases, forming with them permanent alliances, dangerous, nay, even fatal to human life; it has opened a new vista in the nature of diseases depending upon these alliances; it has lifted the veil from solar and stellar chemistry; it has enabled us to enter nature's most secluded laboratory, and to cast a glance into the fathomless depth of creative energy!

In medical jurisprudence its use is far-reaching, and of unlimited importance. Its simple application, its response to the minutest material of blood, its extraordinary delicacy and sensitiveness, gives to the spectrum test the greatest value and the most extended scope. It responds decidedly and immediately where the highest magnifying powers of the best microscopes can no longer give any information. It gives us valuable and often instantaneous

information, by reaction for every alteration that blood undergoes when acted upon by poisonous gases, and those of minerals or other destructive agencies, and it is a powerful means to unravel the secrets of crime. Well may we say, "no medical man can claim to stand at the height of medical culture who is ignorant of the results of spectrum analysis."

HISTORICAL.

Our account of the rise and progress of spectral analysis must be brief, although it is full of intrinsic interest, the space allotted to me forbidding a fuller and ampler detail. Sir Isaac Newton may be justly called the father of spectroscopy. He discovered, or first saw the spectrum in 1675; he promulgated then his masterly and unsurpassed prismatic theorems. He grappled with the subtle question of light, and his emission theory, although disproved in our days, stands out yet as the bold and ingenious structure of a giant mind. He darkened his room, made a round hole in the shutter of the window and allowed a sunbeam to cross his room. This beam he intercepted with a prism, and had the inexpressible pleasure to see the beautiful spectrum, the colored band containing all the tints of the rainbow in exquisite beauty and splendor. But his discovery was barren in practical results. The way the sunlight entered Newton's room prevented him from seeing the sunlines, which, in our days, have become the means and landmarks of remarkable discoveries. Instead of a round hole we now use a narrow slit that prevents the over-lapping of the sunrays and makes the observation of the sunlines possible. In 1752, Melville experimented with colored flames. Pierre Prevost wrote on the identity of heat and light. Wollaston discovered the dark sunlines in 1802, but he failed to make any practical application of his important discovery. In 1814 Frauenhofer, of Munich, used, examined and studied these lines more thoroughly. He mapped and named the most prominent of them with the letters of the alphabet from A to H, and used them as standards for measurement, and to this day, *they are known as the Frauenhofer's sunlines.* He also examined the light from the moon and from Venus, and found the same spectral lines at the same distance from each other. He observed that in Sierius, in Cygni, and in Capella, the arrangement of dark lines differed from those observed in the sun, and he concluded that these lines were caused by some absorbing power in the sun and in the stars.

But the deep importance and origin of these lines remained undiscovered until up to a very recent period. In 1861 Sir David

Brewster published a map known as Brewster's & Gladstone's, containing dark lines by atmospheric influence or absorption in various parts of the spectrum. These telluric or atmospheric lines are most plainly seen when the sun is low on the horizon, because the strata of vapors and moisture which the rays have to traverse, are more compact and longer. Sir John Hirshel investigated the spectrum of flames, especially of strontium, in 1827, affirmed, that in this way we could detect extremely small quantities of this body.

Swan published, in 1855, that the $\frac{1}{1000000}$ part of a grain of chloride of sodium would respond to the spectrum test.

In 1824 Talbot discovered and described the bright lines of lithium and strontium, and he did not hesitate to say, "that by means of spectrum analysis we can distinguish the minutest quantities of these substances."

Then came the examination of the electric arc by Frauenhofer, Wollaston, Focoult, Masson, Angstroëm, Van der Willigen and Dore.

Pflucker examined the spectra of various gases in tubes made by Giessler.

Janson investigated the absorbing powers of steam and water vapor.

Pater Sechi, of Rome, discovered by means of the spectroscope, water vapors in the vicinity of the sunspots.

Sir Charles Wheatstone, in 1835, says in his historical report on the prismatic decomposition of electric, voltaic and electro-magnetic sparks: "These differences are so obvious, that one metal can easily be distinguished from the other by the optic appearance of its spark." Then came the most interesting investigations of Angstroëm, in 1857. He mapped more than 1000 of these sunlines, and this map, unsurpassed in correctness and amplitude, is known as the map of Angstroëm and Thalen.

Such was the condition of spectral analysis when Kirchhof and Bunsen, two eminent savans at the University of Heidelberg, with an improved spectroscope of their own construction, initiated their wonderful and brilliant discoveries, which have revolutionized the entire field of solar, stellar and siderial chemistry. One of the earliest fruits of their labors, was the discovery of two new alkaline metals by Bunsen in 1860. He was engaged in the examination of the alkalies left from the evaporation of a quantity of the mineral waters from the springs at Durkheim. On examining them by the spectroscope, he saw some bright lines which he had never observed before.

He immediately had forty-four tons of this water evaporated, from which he obtained two new metals in very minute quantity. He called them cæsium and rubidium. Since their providential discovery, these two metals have been found in many of the most celebrated springs in the old world. The quantity of the two new metals thus obtained by the evaporation of the forty-four tons of water was nearly 200 grains. This eminent chemist succeeded in separating these two metals and to establish their properties chemically and spectroscopically.

The springs of Bourbon les Bains, Baden-Baden, Vichy, Gastein, Nauheim, Karlsbad and others contain either the one or the other, or both these alkaline metals in minute quantities, and much of the curative powers of these springs may be due to their presence, although in such minute quantities.

Rubidium has a wider distribution than Cæsium, especially in the vegetable kingdom. We find it in the beet, in tobacco, in the ash of the oak (the quercus pubescens), in coffee, tea, as well as in cocoa.

Not long after this, in 1861, the third new metal was discovered by means of the spectroscope by W. Crooks. This new metal bears the name of thallium.

Reich and Richter, of Freiburg, Saxony, discovered a fourth new metal, indium, by the spectral test.

Another, the fifth, named gallium, was discovered by Lecoc de Boisbaudran.

Great as these discoveries were, thus initiated by the eminent men in Heidelberg and elsewhere, there were still higher triumphs in store for the prismatic test. In 1859 Kirchhof desired to ascertain the accuracy of the often asserted coincidence of the bright sodium line, produced by burning the metal sodium, and the dark or black solar D line seen in the spectroscope.

He placed a burning sodium flame before the slit of his spectroscope, and lo! he saw the dark D line change into a beautiful yellow bright line. Then he directed bright solar light to pass through the sodium flame, and beheld the bright line changed back again to the dark D line. Thus he found the solution of his inquiry. The two lines were coincident, identically the same. These experiments led him to the logical conclusion that the dark D line resulted from burning sodium in the sun, and that there must be some vaporous envelope which absorbed the yellow bright line, and converted it into a dark line ; he further concluded that both the bright and the dark

lines had a common origin, and that therefore wherever this line appeared in the spectrum of any sun or stars, it would prove that sodium was one of its constituents. Having arrived at this conclusion, Kirchhof compared the spectral lines of other minerals and metals with those of the sun. His own results, and those of many other physicists, were highly satisfactory and went to prove that most of our terrestial gases, metals and minerals constituted the component part of the sun's body, and those of the stars.

Thus was the foundation laid for one of the greatest discoveries of the age, and a new and almost infinite vista was opened into the nature and composition of worlds, of which a quarter of a century ago we had not the least knowledge or presentiment.

Kirchhof thus established and mapped the coinciding dark sunlines, with the bright lines of the following metals: sodium, calcium, barium, magnesium, iron, copper, zinc, chromium, strontium, cadmium, nickel, cobalt, potassium, rubidum, lithium, tin, antimony, arsenic, cerium, lanthanum, dydimium, mercury, silicon, aluminum, plumbum, gold, silver, ruthenium, glucinum, iridium, platinum and palladium. Huggins mapped in addition the spectra of thallium, tellurium, bismuth and osmium. In 1849 Thalen found the spectral lines of the rare metals zirconium, yttrium, thorinium, uranium, titanium, tungsten, molibdenicum and venadium.

No sooner were the discoveries by the aid of the spectroscope, in chemistry and astronomy made known, than the attention of the scientific and professional men was directed to the inquiry, whether the marvelous analytical powers of this instrument could not also be employed in the service of medicine. This inquiry, upon whose solution the best minds of Europe were engaged, has given a highly satisfactory and affirmative answer, and its adaptation to physical research will furnish us the material for this present essay.

The first results in this direction were secured almost simultaneously by Professor Stokes in London in 1862, and Hoppe-Seyler in Tübingen. Hoppe-Seyler's discoveries were published in 1862, under the title of "die chemischen and optischen Eigenschaften des Blutfarbestoffes." (the chemical and optical properties of the coloring matter of the blood), were published in the Archiv for Pathology, Anatomy, Physiology and Clinical Medicine. Stokes' researches were published in the Proceedings of the Royal Society of London, 1864, under the title, "On the reduction and Oxidation of the Coloring Matter of the Blood." Gamgee followed with "The Action of Nitrates on the Blood," in 1868. Pflucker and Hittorf published

their highly important observations on the spectra of gases in 1865. Sorby invented his micro-spectroscope and published his observations on blood-stains, and the qualitative and quantitative analysis of animal and vegetable coloring matters. Valentine followed with his work "On the Blood." In France appeared the work of R. Benoit, "Etude Spectroscopic sur la sang," and that of Victor Fumoze, "Les Spectres d'absorption," Paris, 1870: "Die Blutcrystalle," by Preyer, in 1871; "Products of Oxidation of Biliary Coloring Matter and their Absorption Bands," by Heynsius & Campbell, 1871; "On the Spectrum Analysis of Urine," by Jaffe, 1868. Then came Malyv "Untersuchungen ueber Gallenfarbestoffe und Oxidationsproducte," *Centralblatt* 1869. My own labors and observations on old blood-stains. "Archives of Scientific and Practical Medicine," edited by Brown-Sequard. In the same direction wrote, "Bogomoloff, Fudokowsky, Prussac, Stockvis, Anderson, Heparius, "On the Absorption Bands of Gallstones. Then came Thudicum's masterly review, "Of the Spectroscope and its Application in Pathology and Chemistry," in the 10th report to the Privy Council, 1868. In addition we have the critical labors of Stadeler, Neurovki, Dybkowsky, Grandeau, Lehman, Koshlakow, Sneider, Virchow, Bird Herapath, Rey Lankaster, Vierord, Semmler, Roscoe, Shellen, Vogel, Watts, Jaederholm, Zach, McMunn, Draper and others. The above brilliant array of scientific men that have given spectrum analysis applied to medicine their critical attention, is sufficient proof of the great and towering importance of the subject under consideration.

THE SPECTROSCOPE—CURSORY RESUMÉ OF ITS USEFULNESS IN MEDICINE.

Not more than a score of years ago it would have been possible to sum up all that the spectroscope could do in the service of medicine in a brief space indeed. Now, at this present day, the material that has been accumulated could not be exhaustively laid before the readers of THE MICROSCOPE in a dozen essays, occupying both an extensive space and requiring a long time. Spectrum analysis has carried us far beyond our former conceptions of the laws of life, health and death. By it we have been enabled to lift the curtain beyond which, since eternity began, those mysterious processes were carried on, which man sought continually to understand, upon which the most strange and conflicting theories prevailed, and which he erroneously supposed could never be unraveled. Its application is simple, and it responds to the minutest amount of material. Indeed, it is this extraordinary delicacy and sensitiveness

of the spectrum test, which gives to its application so great a value and so extensive a scope. It responds *distinctly* and *immediately* where the highest magnifying powers of the best microscopes can no longer give us any information. It gives us a most valuable reaction for every alteration or change which blood undergoes when acted upon by physical or chemical agencies; it analyzes the flames of gases, and those of mineral and metal poisons, and unravels the secrets of crime, depending upon the administration of these destructive agents, with wonderful precision and unimpeachable certainty.

SPECTROSCOPIC ANALYSIS.

By spectroscopic analysis, we understand a scientific process or procedure in which light, solar, stellar or artificial, is made use of to analyze and demonstrate both organic and inorganic substances. The instrument employed consists of a system of prisms and lenses by which rays of light are broken up into a series of colored tints called a spectrum, and which offers to the eye all the colors of the rainbow with great beauty and brilliancy. We call this instrument a spectroscope, and if adjusted to a microscope, a micro-spectroscope. The spectroscope may have one or many prisms; the more good prisms a spectroscope has, the higher and greater is its dispersive power. Two or more telescopic tubes may enter into its construction. One tube is provided with a slit arrangement to admit and regulate the admission of light. The source of light may either be an oil or petroleum lamp placed before the slit, or we may utilize sun and starlight; other illuminating sources are furnished by the oxygen lime-light, by burning magnesium, the electric arc, and various other artificial means. One of the tubes carries also one or more collemator lenses, which are necessary to collect the admitted rays and to make them parallel. The light, in passing through the prism or prisms, is refracted, and its rays broken up in a colored image or spectrum, which passes to the observer's eye and is appreciated by the retina. By appropriate means we can also throw the image upon a white screen. For some instruments there is a very useful and necessary scale attached, which divides the spectrum in a certain number of degrees, usually 140. It is very useful to locate very definitely the bright and dark lines and absorption bands, especially when working with artificial light, which cannot produce the Frauenhofer sunlines. The scale was introduced by Steinheil.

In the micro-spectroscope, the mechanism is such that two

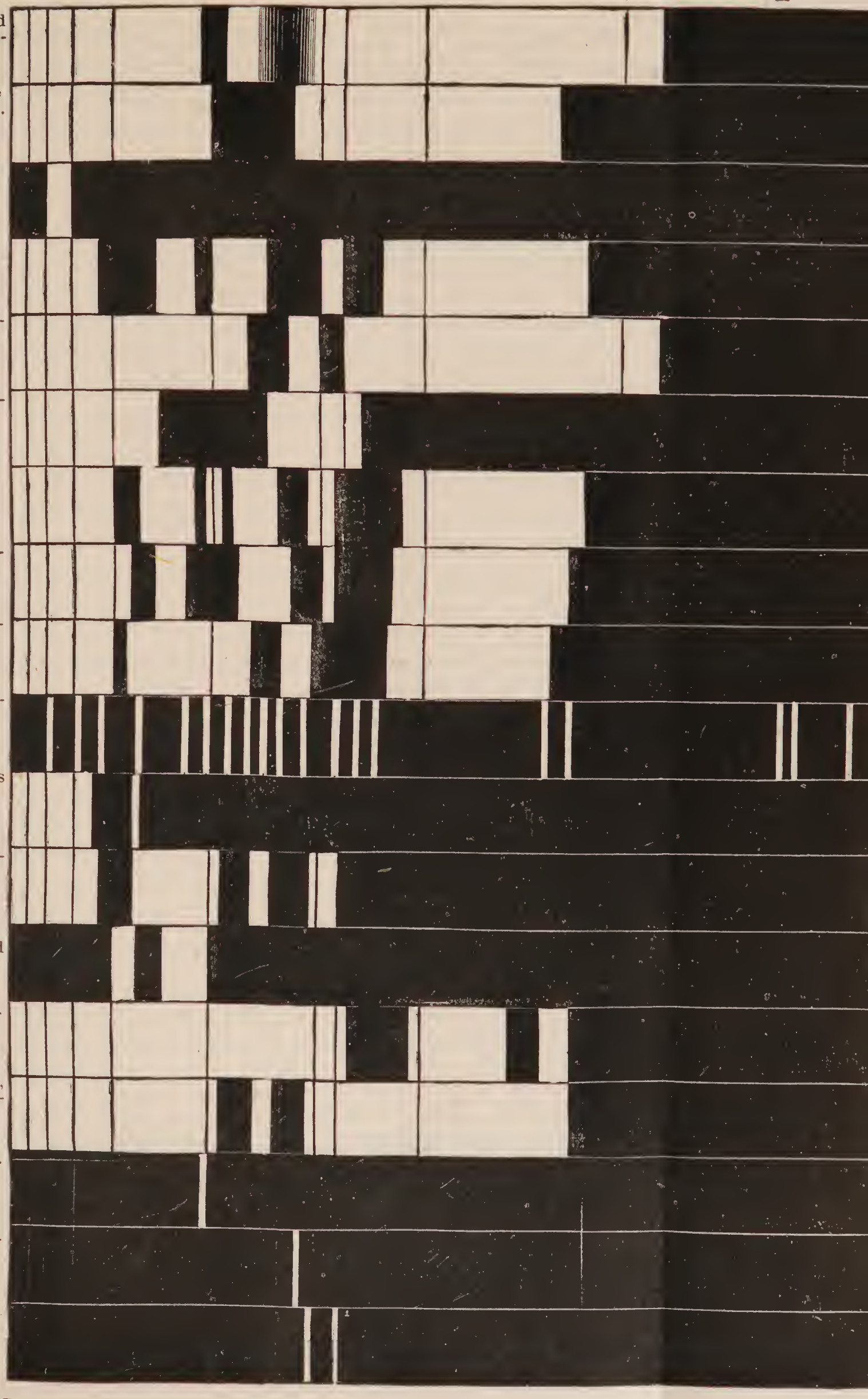

A a B C D E b F G H
Oxidized blood or oxyhæmatocryst.
Reduced or de oxidized blood.
Concentrated blood.
Acid hæmatin.
Reduced hæmatin.
Alkaline hæmatin.
Five-banded hæmatin.
Alkaline cruentine.
Reduced cruentine.
Ash from human remains.
Old blood stains
Old blood oxidized.
Sulphuretted hydrogen blood
Hæmatoidine..
Carbonic oxide, hamatocrystalline.
Sodium.. .....
Thallium. .....
Silver.....
Red.
Orange.
Yellow.
Green.
Blue.
Violet.

PLATE III.

spectra can be seen side by side. Whilst one shows absorption lines the other shows the Frauenhofer's lines, and admits of locating any band or bands. We call these spectra, comparing spectra, Vergleichresspectra. Thus, if we desire to ascertain whether two substances are alike, especially fluids, we obtain two spectra, a fact which will answer the question at once.

Another mode is to fix the position of any spectrum we employ in the interior of the tube of observation, *i. e.*, the one that carries the eye-piece, either a fine wire, a bright line or cross, which may be moved along the spectrum and the scale. Such an arrangement may be found in Browning Soby's bright line micro-spectroscope.

At some future time I shall enter more in detail, and until then I must also defer the discussion and description of the difracting spectroscope.

My readers probably all know what happens when a ray of light passes through a prism. Such a ray is decomposed, filtered as it were, into its ultimate component parts, consisting of various colored rays spread out fan-like, forming the spectrum. It contains all tints of the rainbow in regular succession, from red to orange, yellow, green, blue and violet. Whence come these beautiful tints, seeing that the rays passing into the prism were white?

Paint all these colors upon a disc and move it rapidly by some mechanical contrivance. The disc will appear white. So, when all these tints in their swift motion strike the retina in the same unit of time, the impression will be that of white light. But when the filtering process begins by means of the prism, some of the tints pass faster through it than others, and although the difference in the passage must be calculated by many billions of oscillations per second, it is sufficient for the retina to be impressed with the various tints and to bring it to the consciousness of the brain.

There is another change witnessed at the same time: in passing through the prism the tints change their straight course and, deviating to the right and to the left, are dispersed. We call this the refraction of rays.

The violet part of the spectrum is far more widely bent out of its course than the red part. This deflection and greater refrangibility of the violet rays depends upon the constitution and nature of light itself, whose waves are propagated through space by the wave-like motion of a subtle, highly elastic fluid known as "the luminous ether." The light waves differ in length; the longest form the extreme red part of the visible spectrum, the shortest those of the

extreme violet. According to Tyndalhl, the length of an ethereal light wave of the extreme red would require 36,918, placed end to end, to cover an inch. As the sun's light comes to us from a distance of more than ninety millions of miles, we can perceive the amazing number of waves, and their inconceivable velocity, considering that these waves reach us in the short space of time of $8\frac{1}{2}$ minutes, making 168,000 miles per second.

The number of luminous ether impulses or oscillations necessary to produce upon the human retina the impression of red light, is therefore 451 billions per second. Five hundred billions of these oscillations will produce the impression of orange ; 550 billions per second are required for yellow ; 600 billions of impulses will make our retina conceive green light, and in order to produce the impression of extreme violet 789 billions of ether oscillations per second are required.

When the human mind stands aghast in contemplating the immensity of such etherial wave-motions, it will further increase our wonderment to learn that we have not yet reached the limit of these extraordinary oscillatory wave-motions; for far beyond the violet end of the visible spectrum, rays exist which are still more refrangible, indeed, not perceptible to the unaided eye, but manifesting themselves by chemical and electrical activities. Helmholz says that "these invisible rays, may be made visible if we darken or exclude the more dazzling lighter part of the spectrum from the field of vision." They may become more distinctly visible by placing a fluorescing substance, such, for example, as glass of Uran, or acidified sulph. of chinin, in the ultra-violet part of an objective spectrum. Such bodies become luminous in the violet and ultra-violet, and shine in lights of lower refrangibility — for example, in green and blue—and thereby make visible the ultra-violet part of the spectrum with its array of lines. Magnesium light, and that of aluminum, is richer in ultra-violet rays than sunlight. The ultra-violet sun-spectrum shows an extension far beyond the visible spectrum. Its lines are very numerous, running down from H to W.

We may also show an extension in the *ultra-red* part of the spectrum. These ultra-red rays are best seen by passing them through prisms of salt crystals; we may thereby elongate the normal spectrum to double its length. The caloric activity of that dark portion of the red end of the spectrum, can be very readily demonstrated.

THE CONTINUED AND INTERRUPTED SPECTRUM.

When we examine the flame of an oil lamp, or that of burning magnesium, or the oxygen lime light or the flame of the electric arc, we receive a continuous spectrum; the tints run imperceptibly into each other, as they do in the rain bow. But when sunlight is thus examined, or the light of the moon or the stars, we observe a spectrum interrupted or traversed by many fine lines, some more prominent and distinct than others, but they always appear in the same part of the spectrum. This we call an interrupted spectrum. There are thousands of these lines which have been mapped with great care, by Thalen, Angetroëm and Kirchhof, and their wave-length determined.

The stars, such as the brilliant Sirius, also give many thousands of lines, but they are differently arranged, and their *prominent* lines differ in position and number from those of the sun. The sunlines are known, as we already adverted to, as Frauenhofer's lines, from A to H. They are delineated on the subjoined diagram, which we advise our readers closely to examine and to study. These lines, whether as presented by the sun or stars, represent terrestial substances, especially minerals, metals and gases. They exist in these celestial orbs in an incandescent vaporous condition. The prominent E line indicates the presence of iron. C, F and G are the lines of hydrogen; calcium has its line at H. We already adverted to the D line indicating the presence of sodium.

A section of the spectrum and its lines were photographed by our own gifted countryman, Rutherford, and it is astonishing how closely his photograph coincides and agrees with the section of the spectrum, drawn by hand by the immortal Kirchhof. Now, all minerals or metals in a gaseous condition, as well as all other natural gases known to us give a bright line spectrum. Numerous experiments have established this fact. How then can we explain the circumstances, that the sunlines are all black. In answer to this query we have pointed out to you another fact, to-wit, that by the simple device of Kirchhof, the bright lines produced by burning terrestrial metals can be changed into dark ones and vice versa, the dark sunlines can be changed into bright lines, making them identical. From this Kirchhof formulated the following law, in 1860.

"That the relation between the power of emission, and the power of absorption of the same kind of rays is the same for all sub-

stances at the same degree of temperature." Thus sodium can absorb by its own vapors, that same yellow light when present in the sun, by passing through in the chromosphere and assume a dark line to our spectral vision.

A NEW FRESHWATER SPONGE.

HETEROMEYENIA RADIOSPICULATA N. SP.

BY HENRY MILLS.

SPONGE massive; specimen 3 x 2½ x 2 inches in thickness; texture close, compact; surface nodular; statoblasts, or gemmulæ, uniformly globular; diameter, .02 parts of an inch; crust thick, charged with two distinct forms of birotulate spicula; the inner ends of both resting on the chitinous coat of the statoblast.

Foramenal opening small, slightly prolonged; not funnel-shaped.

Skeleton spicula generally smooth, a few sparsely microspined; curved, moderately sharp pointed; length varying from .012 to .014 parts of an inch; long birotulates vary in length from .007 to .009 parts of an inch. From thirty to sixty of these project irregularly from each statoblast, reaching out beyond the shorter birotulates, one-fourth or more the diameter of the statoblast, and terminating in rotulæ, consisting of numerous strong recurved hooks, some of which are turned inward pointing directly to the shaft. Shaft more or less spined, slightly curved, larger in the middle; width of rotulæ, .0012.

Shorter birotulates large, symmetrical, with irregularly dentate rotulæ; rotulæ boletiform; shafts straight, strongly spined, spines at right angles to shaft tapering to a point.

Length of short birotulate, .003 inches. Width of rotulæ, .001. Dermal, or flesh spicula numerous throughout, small, hexradiate-stellate; with rays or arms of various extent proceeding in all directions from a common center; center without form or other character, except that which is incident to the junction of the many spines which make up the spiculum. Average extent of stellate spicula measured from the ends of opposite rays, .001. Rays sometimes of uniform thickness, occasionally enlarged at the ends with microspines, curved inward.

There are also many small spicula with one or two long arms, forming an axis from which proceed other rays or arms perpendicular to the axial rays. These are all microspined, sometimes with blunt terminus, and sometimes tapering slightly.

The two kinds of birotulate spicula found in the statoblast of this sponge, as already described, bring it into the genus *Heteromeyenia* Potts. But for this feature it must be classed, at least, as a remarkable form of *Meyenia plumosa* Carter. Forty years ago, Mr. Carter, of England, found his specimen of the last named sponge, in the water tanks of Bombay, India. This he described in 1849. No other specimen, nor variety of it was found again, till three or four years ago, when Dr. Palmer found a variety of it on the banks of the Colorado river. This was described by Mr. Potts, who named it *Meyenia plumosa* variety *Palmeri.* See his description in his monograph of the freshwater sponges.

As the term used to designate the generic character of this entirely new form is technically expressive of one of its peculiarities, I have thought it best to use a specific term, which is also expressive of the stelliform spicula; which, among all the freshwater sponges, as far as I know, are only found in this and the two allies above named. It will therefore be known as *Heteromeynia radiospiculata.*

This sponge was found in the Ohio river, 12 miles from Cincinnati, by my friend, Mr. George B. Twitchell, in September, 1887, and sent to me in November, same year. I acknowledge my indebtedness to Mr. Twitchell for several other specimens found also in the Ohio river. Among them are *Carterius tubisperma* Mills. A fine specimen of *Tubella Pennsylvania* Potts, and *Spongilla lacastris* Aucht.

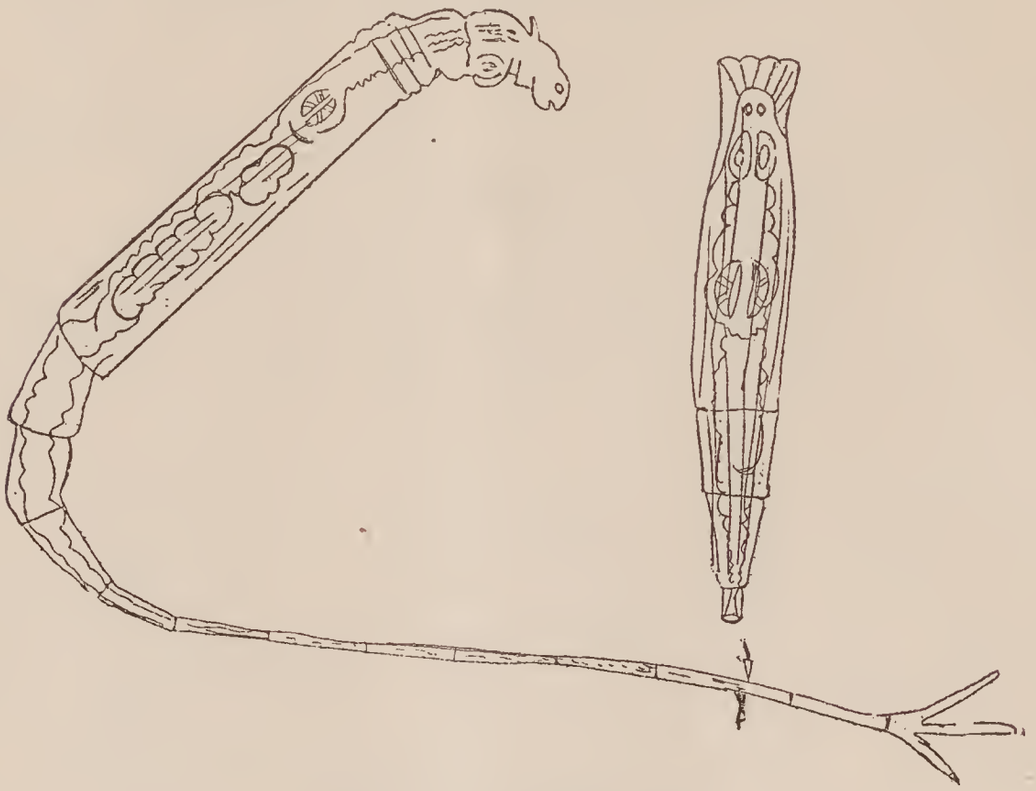
162 FARGO AVENUE, BUFFALO, N. Y.

ACTINURUS NEPTUNIUS.

C. C. MELLOR.

THIS singular Rotiferm I had the good fortune to find lately on some ceratophyllum, growing in a little pond alongside of a cow stable in one of the suburbs of our city. It was quite a cold morning, about November 1st, when I visited the pond; it was covered with a thin sheeting of ice, and no plants were visible; but I soon raked some dilapidated looking specimens from the shallow bottom. On examination I found the leaflets swarming with various rotifera and infusoria, but my attention was soon attracted to a rotifer extending itself to a seeming interminable length, and on four slides I discovered fully twenty of them. Further examination proved them to be Actinurus Neptunius, as described in Hudson & Gosse's recent monograph on the Rotifera, and their description coincides exactly

with the specimen seen. As this Rotiferm seems to be rather rare in England, and I have never heard of it having been observed before in this country (and Dr. Kellicott writes me to the same effect), it occurred to me that perhaps the readers of THE MICROSCOPE would be interested in the accompanying cut and description (somewhat abbreviated), taken from the work above referred to.



(Reduced from Hudson & Gosse.)

GENUS ACTINURUS.—EHRENBERG.

Gen: Ch: Whole animal excessively long and slender; eyes, two, frontal; teeth, two, converging.

There is little but its extreme length and tenuity to distinguish this genus from Rotifer, but these characteristics preclude mistaking it for any species of Rotifer, as soon as seen. Even in contraction, the trunk is not sensibly thickened, never swelling in the middle as it does in other genera of the family.

ACTINURUS NEPTUNIUS.—EHRENBERG.

Sp: Ch: Frontal column short, eyes near its base; corona small; trunk, long, slender, cylindrical; foot protrusible to twice the length of trunk; spurs small, two-jointed; toes, very long, recurved.

From its extreme length and tenuity, the appearance of the creature is very remarkable, and may be likened to a cylindrical tube, out of which protrude a great number of draw-tubes from both extremities, principally the posterior one. The head is peculiar when viewed laterally; ovate in form; frontal column very short; eyes,

oval, dark and large; antenual tube projecting obliquely backwards, looking ludicrously like the head of a rabbit. The rotatory organs are small, and seldom unfolded. The eight or nine joints of the foot are of extreme slenderness; the spurs consisting each of two joints. The three long, slender toes, are flexible and commonly bent outward. The mastax is at a considerable distance from the corona, and is reached by a long buccal funnel; each ramus bears two inwardly converging teeth. The ovary is obvious, and the appearance of the eggs suggests that the animal is viviparous. This singular creature is lively in its motions, and it is a curious sight to see the immense length of foot suddenly thrust from the body, in which it had been completely hidden, the starting out of the horizontal processes, and the diverging of the long toes, as these are successively uncovered.

Length, fully extended, $\frac{1}{22}$ inch; closed, $\frac{1}{70}$ inch. Habitat. North London; Leamington; Caversham; rather rare.

PITTSBURGH, PA.

PROCEEDINGS OF SOCIETIES.

THE BUFFALO MICROSCOPICAL CLUB.

THE regular December meeting of this Club was held on the evening of December 13, 1887, in its rooms in the Buffalo Library Building.

Before the reading of papers, an animated discussion, principally one-sided, sprang up, caused by the reading of Prof. Minot's, of Boston, article in the current number of *Science*. This attacked American microscopes and declared them unworthy of confidence. It was stated by several of the members that the paper was a libel because it was untrue; grade for grade, the American was the better instrument every time; that our upper grades of lenses were better, and that America had been at the front since 1847. Were names mentioned the above statements would be unquestioned. A committee was appointed to express the general feeling of antagonism of the Club to Dr. Minot's article, as it was felt to be a blow in the face to all those who had been working to advance microscopy, technical and mechanical, in this country.

The first paper was by Dr. Geo. W. Lewis, Jr., on "The Ray Fungus." The doctor spoke, without notes, briefly as follows: The Ray Fungus is a vegetable organism, found in marshy districts, attached to leaves and grasses; it is readily introduced into the

animal organism and gives rise to the "foot and mouth disease." There are a few cases on record of its being transmitted to man, the disease being called "actinomycosis," affecting the tongue, glands in the neighborhood of the lower jaw, and, being metastatic, sets up abscesses in the lungs, liver, etc.

Prof. Jno. F. Cowell read a technical paper on "The Fertilization of Plants." He illustrated on the blackboard the difference in the sexual organs of the different orders of plants and the methods by which each was fertilized.

A memorial to Dr. L. M. Kenyon and Dr. A. M. Barker was presented by a committee and adopted by the Club. Both these gentlemen were old and honored members of the Club, and in their decease the Club loses true friends and willing workers.

L. A. BULL, *Secretary.*

THE LOUISVILLE MICROSCOPICAL CLUB.

MEETING, Tuesday, November 29: The President, Rev. C. J. K. Jones, in the chair. Prof. E. H. Mark gave the first talk, his subject being "Angular Aperture, a formula for its determination and the best angles for lenses for ordinary work." While the professor had not much more than begun his investigation of the subject, his talk was very instructive. He promised a paper bearing on the matter at an early date, when I hope to give your readers a full report.

Meeting, Tuesday, December 13: The President in the chair. The paper of the evening, "Typhoid Bacilli, and a report of their detection in water obtained from spring ice," was read by Mr. Simon Flexner. The discussion which followed had reference to bacteriology in general. The question raised by Dr. Minot, in his letter to *Science*, on "American Microscopes," was discussed. The opinion of the Club was largely in favor of American stands and objectives. Some photographs of Amphipleura pellucida, made by Dr. Ditmers with Spencer's $\frac{1}{10}$-inch objectives, were exhibited. One of the photographs was from a negative in which Amphipleura was shown resolved by plumb central light.

SIMON FLEXNER, *Secretary.*

ELEMENTARY DEPARTMENT.

A COURSE IN ANIMAL HISTOLOGY.

BY FRANK W. BROWN, M. D.

FIRST PAPER.

(*Concluded.*)

INSTRUMENTS AND REAGENTS.—Although the reader will be supplied with many of the necessary articles used in histological work, it may be convenient to give a list of those more generally employed. If others are needed for special work they will be given at the proper place.

INSTRUMENTS.—A large number of instruments is not necessary. It is a bad plan to purchase and depend on the many elaborate tools designed for a special purpose, especially when the work can be more satisfactorily accomplished with some simple instrument guided by a practiced hand. Every endeavor should be made to train the hands that they work skillfully, and this can best be done through the use of simple appliances which demand a certain amount of manual dexterity to accomplish the end for which they are employed. Nearly all ordinary work can be done with this outfit: 1. Two or three scalpels, one of which should be very small and another quite large and strong. It is not necessary that the blades should have special shapes. 2. Three or four needle-holders provided with straight needles of moderate size. 3. Two pairs of delicate forceps with soft springs. One pair should be without teeth. 4. Two pairs of small scissors, one of which should be curved. 5. A half-dozen camel's hair brushes, two of which should be exceedingly fine, slender and pointed. These latter should be fitted with handles. 6. A dozen deep watch-glasses. Those known as the "Syracuse solid watch-glass," manufactured by The Palmer Slide Co., of Cleveland, Ohio, will be found very convenient. They should be of the finest quality, as imperfect glass does not make a good background. 7. A package of the finest cigarette papers and a sheet of paraffined paper for use as lifters. 8. Slips and covers. The slips should be 3 x 1 in., of good quality of glass, and ground edge. It is not economy to buy cheap slips. The most generally useful cover-glass is the $\frac{5}{8}$-inch circle. Larger and smaller sizes should be kept. Do not get the thinnest, as they are liable to break in handling and are only necessary for use with the higher powers. 9. A microtome. To do good work it is abso-

lutely essential to possess a microtome. It saves an immense amount of time and patience, and does work which cannot possibly be done by hand. The writer has found the microtome made by Schanze, of Leipsic, as the most satisfactory for general work. Several American manufacturers make microtomes on the same model and which serve equally well. (See page 214, vol. VII.)

10. Glassware and china. Under this head come a large number of articles. If one wants to luxuriate, let him do so here. Glass boxes with tightly-fitting covers and of various sizes, china bowls and saucers, bell-jars, etc., are all necessary.

REAGENTS.—All reagents should be kept in glass-stoppered bottles, and before using the contained chemical the portion around the stopper should be carefully cleansed from all dust. The following reagents will be required for ordinary work: Alcohol, 95–97 per cent.—absolute alcohol is much more expensive and no more useful than that of 95 per cent. strength; dilute acetic acid; caustic potash, 50 per cent. solution; hydrochloric acid; nitric acid; sulphuric acid; "normal" salt solution ($\frac{1}{2}$ per cent. solution of Na Cl.); distilled water in large quantity; glycerin; oil of cloves; turpentine; Canada balsam, thinned with chloroform; a cleaning mixture for slips and covers, composed of equal parts of benzol, turpentine and benzine; ammonia carmine; Friedländer's solution of hæmatoxylin; a solution of picro-carmine; picric acid in crystals; nitrate of silver, $\frac{1}{2}$ per cent. solution, to be kept in a dark glass bottle or one wrapped in blue paper; tincture of iodine.

The above list is rather extended, but contains nearly everything required. The formulæ for the stains can be found in the Elementary Department of last year. In making up the hæmatoxylin stain, use the crystals rather than the extract. The result will be certain and the solution much clearer and more permanent.

The ammonia-carmine may have an excess of ammonia. The usual proceedure is to drive off the ammonia. Though this insures a truer carmine tint it lowers the value of the solution as a stain. A slight excess of ammonia (and, in some cases, a large excess) will cause the stains to work more rapidly and completely.

RUDIMENTS OF PRACTICAL EMBRYOLOGY.*

W. P. MANTON.

§ 3. In order to develop the *germ* in the egg, an incubator of some kind is necessary. For this purpose we may utilize a setting hen—the cheapest, but most unsatisfactory method—or a simple

*Copyright, 1888.

incubator may be constructed by any tinsmith, as follows: A strong tin box with copper bottom, having a deep indentation on one side, is made (see cut).

Into the indenture two wooden drawers, each with a bottom capacity for a dozen eggs, are fitted (c c); and the whole can encased in wood. Between the tin and the wooden box there should be room enough to pack a considerable amount of cotton or sawdust, to keep the warmth generated, in the can. The can must be supported on legss everal inches above the bottom of the wooden box in order that a gas lamp may be slipped under it.

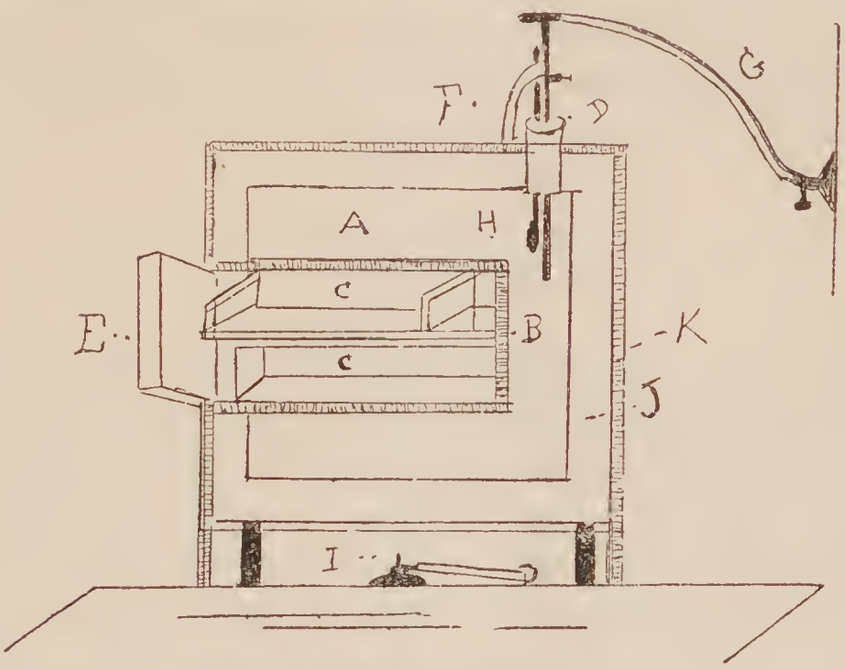


FIG. 1.—Section of Incubator.

A—Tin Box; the interior of which is filled with water.
B—Indentation with wooden drawers c c., closed by
E—Door, which is double, and packed with cotton.
D—Cork, perforated by thermometer and regulator.
F—Rubber tube from regulator to gas-lamp I.
G—Gas supply tube to thermoregulator.
H—Thermometer, and thermoregulator projecting into water.
J—Packing between tin box and wooden casing.
K—Outside wooden casing or box.

The case and can are perforated at one posterior corner by a tin tube which is stopped with a large cork (D), through which pass the thermometer and the thermoregulator—the latter connected by rubber tubes (F. G.) on one side with the gas jet—and on the other with the small lamp below (I.)

Probably the best and simplest thermoregulator is that known as "Reicherts." This consists of a thermometer tube filled with mercury—the upper end of which is dilated to receive a glass T-shaped piece, also of glass, into which the gas streams and is conveyed through the rubber tube F. to the lamp below—the amount of gas being regulated by a graduated screw. As the temperature

increases, the mercury rises and stops the aperture in the end of the T piece—and thus the gas flame is lowered and an even temperature maintained. The gas, is, however, not extinguished—as a small hole in the side of the T, admits just enough to keep the flame lighted. A thermometer is placed by the side of the regulator so that the temperature of the water with which the can is filled, may be determined—and the size of the gas flame regulated accordingly.

The drawers should be partly filled with cotton in which the eggs are placed and lightly covered.

The water should be kept at 37° to 40° C. Hen's eggs thus incubated hatch in about three weeks. Instead of the above home-made apparatus, a patent incubator may be had at the outlay of a few dollars.

(To be Continued.)

EDITORIAL.

IN looking over the various text-books and other publications dealing with microscopical subjects, one cannot fail to be impressed with the clear, fine-cut appearance of the usual illustrations. To one not familiar with the subject, a study of many of these illustrations should lead him to the conclusion that microscopy, so far as observation goes, is not a difficult thing to master. And this, indeed, has been the case, in our experience, with students who have come to us for instruction in histology. The first rude awakening often comes to the beginner when he takes his text-book cut as a guide to lead him through the intricacy of his first mount. Everything looks so differently from what he expected, and even the instructor, in attempting to point out the features so clearly displayed in the cut, will, for some time meet with but feeble success. It may be urged that the difficulty is that the eye requires a special training to enable it to convey a correct impression under conditions to which it is not at all accustomed. This is very true; but is it the only reason for such complete (and not uncommon) failures to see anything at all? It seems to us that one cause of failure is to be looked for in the illustrations, and the reason is, generally, that they are too diagrammatic. We think that the better class of illustrations in question are very helpful to the advanced worker, not because they are true pictures—for they are not—but that he has learned to take something for granted and to make just the proper allowances to enable him oftentimes to know exactly what the artist intended. No specimen, however well

prepared, can show such clear differentiation of its component parts as the illustration which represents it. The latter has caught the general features, exaggerated them and bothered not at all with the spirit of its subject. The aim, moreover, has been, apparenty, to picture the specimen, not as it looks, but as it is. For the benefit of the beginner this should be reversed: he must first learn to see the specimen as it looks, and then taught to know it as it is.

The difficulties at the root of the matter seem to be (1) the fact that the delineations are not confined to that which is seen at a single focus, but are deduced from a knowledge gained by a study of several focuses, and (2) the process employed.

(1). It is this which makes complete tubules in a section where there are few, if any, and which fills up the indistinct spaces with ideal representations of that which, though not seen, is known to be there.

(2). The process usually employed makes use of distinct lines, something seldom seen in a specimen. A skillful artist could probably etch a tolerably correct picture, and he would do so by carefully toning down his lines to the proper degree.

Photography and many new processes are coming into use, some of which, it is hoped, will prove more satisfactory. And yet we think that much better work could be done with the method now in vogue, (drawing with the use of a camera lucida and photo-engraving the result) if the artist confined himself to drawing that only which he sees at one focus, and conserving that blending of parts which, though sometimes amounting to indistinctness, has at least the merit of being natural.

IT is with deep regret that we record the death by paralysis, January 30, of Dr. Asa Gray, professor of botany at Harvard College.

Prof. Gray was born in Paris, Oneida county, N. Y., Nov. 18, 1810. At the age of 21, he graduated from the Fairfield College of Physicians and Surgeons, of Herkimer county, N. Y., and began the study of botany with the late Prof. Torrey. In 1834 he was appointed botanist to the United States exploring expedition—but on account of the delay to which that body was subjected, Dr. Gray resigned his position. In 1842 he was appointed professor of natural history at Harvard College—but devoted his time largely, and at a later period exclusively, to botany. In 1855 Dr. Gray succeeded Prof. Agassiz as a regent of the Smithsonian Institute, at Washington, D. C. Prof. Gray was a voluminous writer, and his

text books on botany are familiar to every school-child in the country. His great intellect, and genial disposition, made him beloved of all with whom he came in contact; and though ripe and full of years —and having seen the flower of his labors rewarded with abundant fruition—the harvest was not yet ripe for the reaper, and in his death, not only America, but the whole civilized world, will mourn a friend—and Science, one of her truest and worthiest disciples.

ACKNOWLEDGMENTS.—From E. S. Coutant, Hawk's Park, Fla., a fine slide of *Gorgonia spicules* from east coast of Florida; from Fr. Dienelt, Melvin, Ill., fine mount of spiracles of *Copris;* from Dr. E. Cutter, a photograph of himself examining blood with a $\frac{1}{10}$ objective, one-inch eye-piece, by direct light of paraffin candle; from Dr. H. J. Detmers, photo-micrograph of *A. pellucida*, taken with a Spencer homog., ims. $\frac{1}{10}$, with "plumb central light." This, although excellent, is hardly as satisfactory as those mentioned in our December number.

BOOK REVIEWS.

WOUNDS, THEIR ASEPTIC AND ANTISEPTIC MANAGEMENT, by David Prince, M. D., Jacksonville, Fla. Reprint.

THE RADICAL TREATMENT OF TRACHOMA, by A. E. Prince, M. D. Reprint.

REPORT ON PROGRESS IN MEDICINE, by J. B. Marvin, M. D. Reprint.

PROGRESSIVE MUSCULAR ATROPHY, BEGINNING IN THE LEGS, by J. B. Marvin, M. D. Reprint.

THE INDEBTEDNESS OF PHOTOGRAPHY TO MICROSCOPY, by A. Clifford Mercer, M. D. Reprint.

PRACTICAL NOTES ON URINARY ANALYSIS, by W. B. Canfield, A. M., M. D. Reprint.

THE STUDY OF THE CAUSES AND TREATMENT OF UTERINE DISPLACEMENTS, by Thomas Addis Emmett, M. D. Reprint.

CYCLOPEDIA OF AMERICAN CONTEMPORARY BIOGRAPHY. Abbe to Anderson. John B. Alden, Publisher.

THE MOSS ENGRAVING CO., and others', Calendars.

THE TONGUE AND GUSTATORY ORGANS OF MEPHITIS MEPHITICA, by Frederick Tuckerman, M. D. Reprint.

ORMSBY MACKNIGHT MITCHELL, ASTRONOMER AND GENERAL. A Biographical Narrative, by his son, F. A. Mitchell. Boston and New York: Houghton, Mifflin & Company. Detroit: John MacFarlane.

This is a very well written and interesting narrative of the life and scientific and military services of General Mitchell. The author has, as much as possible, given General Mitchell's own words. General Mitchell's military career, as cadet, lieutenant, and later as a corps commander during the war, throws an exceedingly interesting side light upon many army facts. His career was cut short before any great opportunity came to him.

As an astronomer, as the founder of the Cincinnati observatory

and director of the Dudley observatory, he is well known to science. His earnest work as a pioneer in this field must give him a warm place in the memories of his fellow-workers, and his well-told story of it will be heartily welcomed.

PHYSICAL GEOGRAPHY, Prepared on a new and original plan by various authors. New York: D. Appleton & Company.

The publishers of this excellent book have rightly decided that the scope of physical geography is too great to be thoroughly covered by one author, and have enlisted the services of a number of men who have national and world-wide reputation in their special departments.

The section on the general structure and geological history of the earth, has been prepared by Dr. John S. Newberry, Professor of Geology and Palæontology in Columbia College; that devoted to the geological history of the North American continent, by Prof. Charles H. Hitchcock, of Dartmouth College; the portion relating to general physiography and the physical features of the United States, by Mr. Henry Gannett, Chief Geographer of the United States Geological Survey; the pages explaining terrestrial magnetism, with the chapters on volcanoes and earthquakes, coral islands, the earth's waters, and meteorology, by Dr. W. Le Conte Sterens, Professor of Physics in the Packe Collegiate Institute. Dr. N. L. Britton, Lecturer in Botany, Columbia College, furnished the chapter on plant-life; Dr. C. Hart Merriam, the Ornithologist of the Department of Agriculture, those relating to zoölogy and the animal life of the United States; Prof. Wm. H. Dall, of the Smithsonian Institution, that on ethnology, and Mr. George F. Kunz, gem expert and mineralogist with Messrs. Tiffany & Co., New York, that on precious stones.

The book is elegantly and profusely illustrated with cuts, charts and maps. As a text-book for students it is without a peer.

ELEMENTARY MICROSCOPICAL MANIPULATION. T. Charters White, F. R. M. S. London: Roper & Drowley, pp. 9–104. 1887.

This little manual, by a well-known writer, is designed for the use of students beginning the study of microscopy. It contains in a well-put form the manipulations so often described in other works, and in addition much that is new, especially to readers on this side of the Atlantic. In spite of the fact that elementary works of this character have multiplied of late years, we feel that the writer has been justified in adding another to the list. We can heartily recommend it to beginners, even though they possess other manuals on the subject.

EXCHANGES.

This department is for the benefit of SUBSCRIBERS *who have microscopical apparatus, material or books which they wish to exchange, and such wants will be* INSERTED FREE OF CHARGE. *The number of insertions given will depend upon the number of exchanges received each month. Subscribers will please notify us when articles have been exchanged or sold. Dealers are referred to our advertising department.*

MR. EDITOR—Will you allow me to say, through the medium of your pages, to the numerous correspondents who have written me in reply to my notice in your Exchange Column, that I exhausted my stock of slides of salicine and urinary deposits within a few days after the appearance of the notice, and that my ever-increasing duties as editor and physician have thus far given me no opportunity to make any fresh ones. Whenever I can get a few hours of leisure I shall make enough to supply all those who have written me, and will give immediate notice thereof in THE MICROSCOPE.
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VOL. VIII. DETROIT, MARCH, 1888. No. 3

ORIGINAL COMMUNICATIONS.

THE SPECTROSCOPE AND ITS APPLICATION TO MEDICAL PRACTICE.*

DR. S. WATERMAN.

[*Continued.*]

DELICACY OF THE SPECTRUM TEST.

THE delicacy of the spectrum test is extraordinary, and surpasses in this direction any other test previously known to the analytical chemist.

Let me quote here the statement of Dr. H. Schellen. In his excellent work, "Die Spectralanalyse," he says: "Suppose we divide one pound of our common table salt (sodium chloride), into 500,000 equal parts. One of these parts, or minute particle, we call a milligramme. In order to weigh out such a milligramme it is necessary to employ the most delicately constructed scales; the weigher himself must possess a high degree of dexterity, and he must proceed with the greatest possible care. But with this performance he has pretty nearly arrived at the limit of possibilities. But what if we should require of him to take one of these milligrammes, and to divide it again into 3,000,000 equal parts? Could he perform this feat? Certainly not. The human mind cannot conceive the minuteness of such an atom of matter. The spectroscope, however, does not recoil from such a supernatural task. It demonstrates the presence of such an inconceivable atom with the utmost precision and certainty. The dusting of a book in the

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remotest part of any large hall will set afloat a current charged with sodium chloride, which is present everywhere, and cause a flash in every flame that lights such hall, and this yellow flash will yield the sodium spectrum, and thus reveal the presence of this metal."

This sensitiveness of reaction is not confined to the sodium chloride alone. The $\frac{1}{1000}$ milligramme of chloride of barium gives a very distinct reaction. Lithium reacts with the greatest promptness to the $\frac{9}{1000000}$ part of a milligramme; strontium to $\frac{6}{100000}$ of a milligramme; caesium to the $\frac{1}{20000}$ part of a milligramme. Thallum, arsenicum, plumbum, antimonium and nickel, and many others, respond to very minute quantities of material also; we have already spoken of the intense sensibility of rubidum.

ABILITY OF THE SPECTROSCOPE TO ANALYZE SOLIDS, FLUIDS AND GASES.

Whenever it is desirable to examine solids, we must bring them into a state of an incandescent, vaporous condition by heat. Some metals and their salts can be examined by means of the Bunsen burner. When a higher temperature is required, we may resort to the electric arc, which is capable of fusing every metal known. When the vapors of metals and minerals are thus examined spectroscopically, we observe bright lines in various parts of the spectral field. We give a few examples in the subjoined diagram. One bright line coincident with the D line, is the sodium line. The single line near E, lying in green, is characteristic of thallium. The two bright lines between E and C, also in green, are peculiar to silver. The spectrum No. 10 is produced from a hydrochloric solution of the ash of the human body. (Thudicum). The spectral field shows many red, yellow, green and blue lines in various parts of a dark field. By careful measurement it is found that these lines are peculiar to six metals—potassium, sodium, lithium, rubidum, caesium and calcium. Magnesium and iron, always present in the ash, are not represented in this spectrum, requiring the heat of an electric arc to make them visible.

In order to examine fluids we place them before the slit of the spectroscope in suitable glass tubes, or vessels with plano-parallel walls. When light is made to pass through these fluids ere it impinges upon the prism, we witness an absorption in various parts of the spectrum, varying, of course, with the fluids employed: these dark bands are called absorption bands. Some colored fluids give one or more bands, as may be seen on the diagram. These bands are changing in position, depth of shading, distinctness of tline, breadth, and manner of appearance, furnishing in this way

landmarks so distinct and prominent that the recognition of a particular spectrum is made easy, even to the novice who is not accustomed to work with the spectroscope.

Gases are examined by means of electric induction sparks. Experience has taught us that diluted gases are good electric conductors, whilst in a state of density they are, without exception, bad conductors. It was Dr. Geisler of Bonn who constructed gas tubes, from which he exhausted the air with an air pump, until about only $\frac{1}{600}$ to $\frac{1}{700}$ of the atmospheric pressure was left. These tubes were then filled with the gas to be experimented with, and the tubes hermetically closed. At both extremities of the tubes, electrodes of platinum or of aluminum are soldered in, so that they can be thereby connected to a Spark inductor. (All other metals would oxidize into the intense heat created). In this state of attenuation the gas offers but slight resistance to the passage of the spark, intense heat is generated, and brilliant and beautiful light is emitted of various colors, changing, of course, with the different gases employed. In a darkened room the display of colors is charming, and this is heightened by the skillful manner with which the glass-blower performs his delicate task. Splendid effects may also be produced by thin-bored thermometer tubes, with a bulb at each extremity, into which the electrodes are fused.

DIAGNOSIS OF GASES BY THEIR COLOR.

Hydrogen, according to Thudicum (who used the thin cored thermometer tubes with bulbous end), gives crimson in the narrow part and reddish light in the wide part of the tube:

	Narrow Part.	Wide Part.
Nitrogen	Violet red.	Violet red.
Chlorine	Green.	Reddish violet.
Bromine	Greenish blue.	Violet.
Iodine	Green.	Fawn color.
Hydrocarbon, C. H. 2	Rose colored.	Greenish.
Carb. Acid	Greenish white.	Same.

DIAGNSOSES OF GASES BY THEIR SPECTRA (THUDICUM):

Oxygen, nine colored lines; the most brilliant; one red and one violet, two in green, two blue, two greenish yellow ones and one dark red line.

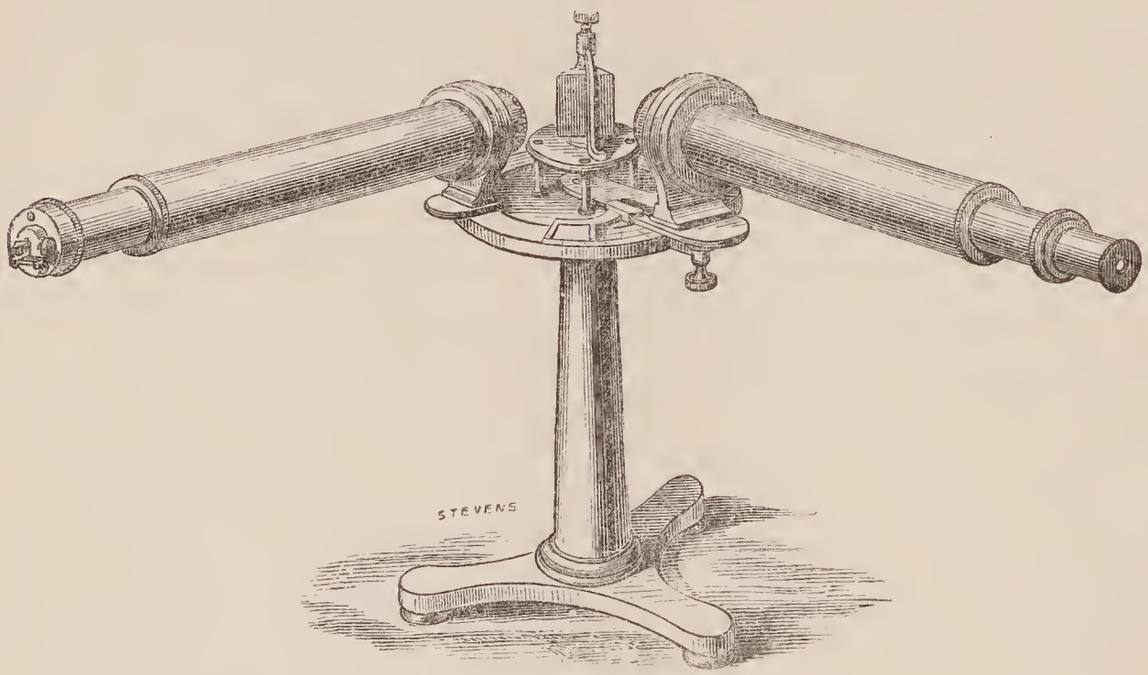
Hydrogen, three light lines, at C, F, and G.

Carbonic oxide, eight colored lines, a most interesting spectrum that shows also dark lines.

Chlorine has six colored and eleven dark lines, diagnostic are four yellowish green lines and a triple blue line.

Nitrogen, a very complicated spectrum, peculiar and easily to be recognized. In the part from the red to light yellow it shows seventeen dark lines. At F. the spectrum shows colored lights or lines. Thirteen of these may be recognized, one in blue and several in violet are most brilliant.

By the foregoing condensed statement it may be learned of how the solids, the fluids and the gases may be analyzed by the spectrum test; that no known substance can defy the analytical powers of this test. Every known gas, metal, alkali or alkaline earth, when thus acted upon by sufficient heat, gives out light, peculiar to itself, producing a spectrum, differing from any other known substance. Some substances absorb all the colors of the spectrum, with the exception of a single bright band, of which sodium and thallium give an example; others are recognized by a spectrum of many bright lines, dispersed all over the prismatic field. Of this, barium, caesium and rubidium are examples.



No. 1. John Browemg's one-prism Spectroscope.

It is true that the degree of heat employed often modifies the spectra; not indeed as to the position of the characteristic lines and bands of each substance, but as to their number and brilliancy. Thus thallium gives one green band when evaporated by a Bunsen burner, but when it is volatilized by the far higher temperature of the electric induction spark or electric arc, we see in addition several bright lines in the violet.

The same is true of lithium, calcium and others. But all these

modifications have been studied and are known, and are as much signs of recognition as the regular spectra are.

One of the most practical results in metallurgy shows the high value of the prismatic test. The examination of the spectrum of carbon has led to a revolution in the manufacture of Bessemer steel. Formerly it was very difficult to determine at what precise moment the oxygen of the air had burned out the carbon and the silicon, a process necessary to produce an excellent steel. Experts who watched the flame and could ascertain by long experience, with more or less exactitude, when the proper moment had arrived, were few and expensive. To the uninitiated no difference of the flame is visible. By the aid of the spectroscope this difference can be made out with the greatest ease and exactitude. A cursory inspection of the flame spectrum and its various phases reveals a certain number of absorption bands and bright lines, and informs us of the exact moment when the iron mass has been converted into excellent steel, when the admission of air and its oxygen is stopped immediately, and the process is finished, with invariable good results. The spectrum of Bessemer steel may be examined in the work of Henry E. Roscoe, second edition, p. 164.

THE SPECTROSCOPICAL ANALYSIS OF THE BLOOD.[1]

In the past, and before the spectroscope had entered into the service of medicine, the microscope was to a great extent relied upon to demonstrate the presence and changes of blood. At the same time the chemical arsenal was ransacked to furnish reactions for the detection of traces of altered blood. Whoever ponders over the painfully tedious and oftentimes faulty proceedings devised and carried out for this purpose, will not fail to hail and appreciate the modern methods of investigation. Chemical analysis is difficult, and often impossible with very minute traces of blood. The microscope can demonstrate blood only within comparatively narrow limits.

So long as the blood-corpuscle can be obtained, and if it is a solitary one only, if well defined, the presence of blood can be made out; but when, by some chemical or other means, the cell form of the blood-corpuscle has been destroyed, when by a process of disintegration every trace of its contour and outline has disappeared, when it has lost all characteristics of blood, and is only presented to us in extremely minute proportions, as an amorphous substance, or as a coagulated, physiologically altered pigment, or in an offensive and putrid mass, then the highest magnifying powers of the microscope

become perfectly useless; it has arrived at the limits of its demonstrating capacity, and it delivers, without hesitation, the further solution of inquiries into the hands of the spectroscope, and it is just here that its analytical powers prove of the greatest importance and usefulness.

THE BLOOD.

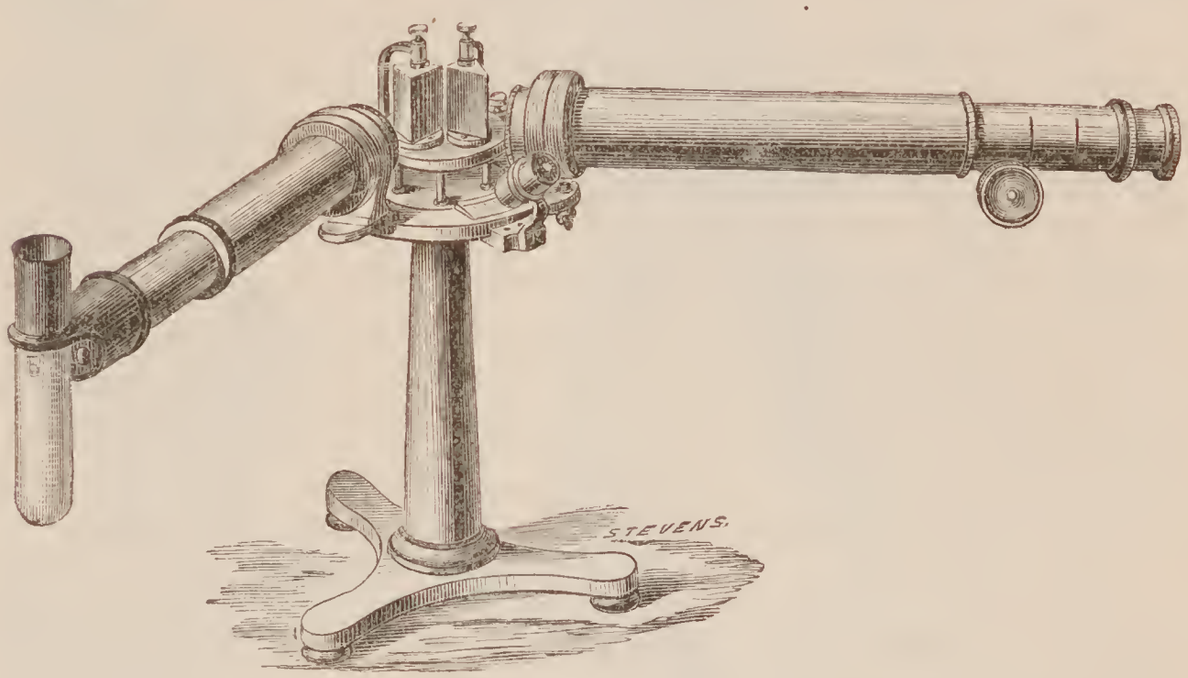
The blood-corpuscle is the highest developed organized cell known. The chemical composition of the blood is calculated according to the following formula: $E\,600.\ H\,960.\ N.154.\ Fe.\ S._3.\ O.177$, leading to an atomic weight of 13280. Its atomic weight and complex composition are the marvel of the analytical chemist. The discovery that these blood-corpuscles contain a crystallizable substance is of recent date. The first observations were made by Reinhart, Koellicker and Funke, and still later by Lehman, Hoppe-Seyler, and others. Lehman gave to this crystallizable albumen the name of "Blutcrystalle"—blood-crystals. This physiologist was however, but partially aware of the great physiological importance and function of these crystals, for in his "Handbook der Physiologischen Chemie," he says that owing to the entire absence of knowledge respecting the chemical constitution of this substance, we are unable to form any opinion regarding its genesis.

Even as recently as 1858, Rudolph Virchow did not assign to these crystals any special function. He was very well aware of the fact that they behaved in certain respects like organic substances, inasmuch as they become larger through the action of certain agencies, and smaller through that of others, without change of form. He was also aware that the form of crystallization was different in different animals, and he adds "that hitherto it has not been possible to discover any satisfactory reason for their existence, or to obtain any insight into the nature of their substance."

And yet he was aware that these crystals were affected by oxygen and carbonic acid precisely as the blood is; that they became of a bright red color with oxygen, and dark and bluish red with carbonic acid In common with the former erroneous views of writers upon this subject, the coloring pigment of the blood, "Der Blutfarbestoff," was described by him as haematine, yet Lehman had already shown that this insoluble substance, so rich in iron, is not found as such in the blood, but that this haematine is in reality a product of decomposition of the true pigment of the blood, which is now known and designated as Haemoglobin, Haematocrystalline and Cruorine.

The great practical importance which attaches itself to the solution of the inquiry regarding the nature and function of this substance, must be my apology for making it the subject of some wider and general remarks.

The spectroscope, which may now be considered as having fairly entered into the service of medicine, has thrown a flood of light upon this and kindred inquiries, and has revolutionized many theories formerly entertained regarding the mysterious processes within our economy, and the results already obtained cannot fail to exert a most important influence upon our conception and treatment of disease.



No. 2. Browning's two-prism Spectroscope, with tube of glass attached to examine fluids.

Recent researches, aided by spectroscopic observation have demonstrated, that the blood-crystals, especially the Haemato-crystalline, are actively at work in the economy to sustain the processes of respiration, oxydation and oxygenation; that they are the true and only carriers of the oxygen of the blood; that through their agency alone is the oxygen of the air attracted to and bound to the blood-corpuscles, which by the heart's action are propelled and carried far into the intricate recesses of the capillary system; that there they part or give up their loosely bound oxygen to the oxidizable tissues, with which they form energetic combinations, that in exchange for their oxygen thus given up, the haemoglobine or haemato-crystalline combines energetically with carbonic acid, the product of combustion, which acid they carry back to the heart and finally to the lungs through the venous tracts, for final elimination. Freed from carbonic acid, they absorb again and again all oxygen

they meet in the lungs, and by the heart's action this vital gas is again carried forward in its endless path of circulation. It has been fully demonstrated by experiments that so long as the haemato-crystalline remains normally the same, in quality as well as quantity, the supply of oxygen to the economy is subject to relatively small oscillations, and with the increase or decrease of this wonderful substance, or with any alteration of its integrity, rises or falls the degree of vitality in an individual's life. That it is beyond any question the haemo-crystalline, and not any other substance of the blood, which enters into and sustains the vital exchanges between oxygen and carbonic acid has been fully proved by spectrum analysis.

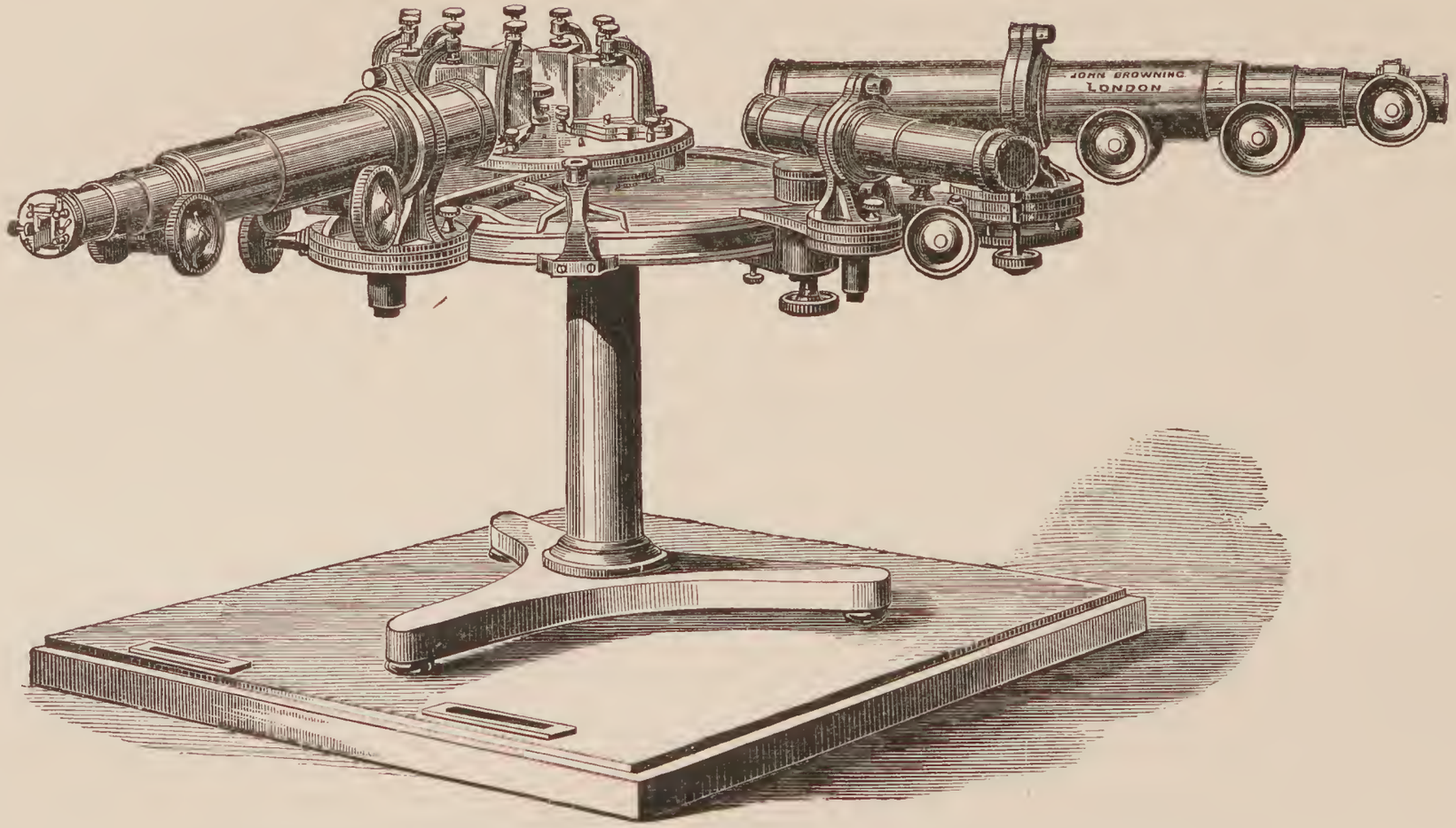
Haemato-crystalline in solution is able to aborb oxygen, as well as carbonic acid, with the greatest avidity. It can exist, like the blood itself, in a double state of oxidation, corresponding to arterial and venous. It can be oxidized and deoxidized at pleasure by chemical, and also by mechanical means. It presents the same absorption bands as blood does when examined spectroscopically, and these blood bands are also found in the exact part of the spectrum; it enters into precisely the same combinations with the irrespirable gases, and all and every optic appearance which blood presents when acted upon by chemical agents, are also faithfully reproduced when the same agents act upon a solution of haemato-crystalline.

As to the approximate quantity of this haemato-crystalline, experiments made show, that in the total blood mass, nine to twelve per cent. is contained in the moist corpuscles; freed from serum, it rises from eighteen to twenty per cent.

THE HAEMATO-CRYSTALLINE AS SUCH IS NOT FOUND IN THE HUMAN BLOOD.

Considerations that would lead us too far from our present subject, and require far more space than can reasonably be spared for this paper, forbid a more detailed account of its normal state in the blood. According to the best authorities, it is there joined to an alkali. When we reflect that the blood is an alkaline fluid, we will at once assent to this proposition, especially so, when experience shows us that this substance can only be obtained in crystalline form, when the blood *loses* its alkalinity and changes to a state of acidity. Thus the prolonged passage of a current of oxygen gas through a blood-solution is one of the means to obtain the artificial crystals.

Preyer thinks that it is joined to potassa in the blood, on



Browning's eight-prism Spectroscope, with high and excellent power and movable tubes, with arrangement for reading ten degrees.

PLATE IV.

account of the predominance of potassa in the blood-corpuscles, whilst soda predominates in the serum. We might say, then, that it exists there as a potassa haemoglobinate.

Perhaps I may digress for a few moments to refer to the rapidity with which oxygen is absorbed and given up again by means of this haemato-crystalline. We may refer to Pflueger's highly instructive experiments with dogs. He forced these animals to inhale pure nitrogen gas; for thirty seconds the highest point of dyspnœa was reached. At this point some blood was abstracted under great precaution, and tested for oxygen. It was found that its quantity of oxygen had been reduced to a minimum, being 1.0 to 2 per cent., whilst the blood abstracted from the same animal immediately before it inhaled the nitrogen was 18.6 of oxygen. As soon as these animals were permitted to inhale again pure air, the dyspnœa disappeared, and they seemed as well as ever.

In hibernating animals the quantity of haemato-crystalline diminishes gradually during the winter's sleep, and is regained at the return of spring.

One of the most wonderful qualities of this substance is its high atomic weight, the highest known. It is computed by I. Schmidt and Hoppe-Seyler, to be 13,280. It is one of the most indestructible substances known, resisting, according to Thudicum, the destructive powers of decomposition and putrefaction. In most solutions it retains its characteristic features, especially its optic properties. I look upon this stability and indestructibility as the principal factor in animal life, and any pathological condition affecting their stability, or their integrity, must also affect the stability of life itself.

Modern investigations have added but additional proof to this assertion. In many instances of disease, most notably in intermittent fever, the destructive microbes select the interior and environs of blood-corpuscles, and health is slow to return unless we succeed in rescuing the integrity of the haemato-crystalline.

Let me here say a few words regarding the inquiry which is so often made, whether we are able to tell in a given case by the spectrum test whether the blood comes from man or not. We cannot with our present knowledge and means, decide the question in a direct manner. The blood of all animals give the same spectral appearances. They all have hæmato-crystalline in their blood; even the lowly rain-worm yields hæmato-crystalline, which proud man claims as his exclusive inheritance. A. Rillet found this substance even in the

red larvæ of the feather-fly, *Chironomus plumosous*. These flies are not parasites; they suck no blood. This proves that the red coloring pigment which forms in their bodies, originates from purely vegetable substances. Chlorophyl gives an absorption band in the neighborhood of sulphurated hydrogen spectrum. We may at times give a negative answer. The microscope can tell us where the size and form of the corpuscles differ from those of man, and whether such blood belongs to inferior animals—for example, the frog's blood. It can also, by the peculiar form of crystallization, tell us what it is not. We know that human blood and that of many carnivorous animals, crystallizes in prisms. The blood of the guinea-pig, of the rat, the mouse and other rodents crystallizes in tetrahedrons. The blood of the squirrel forms hexagonal tablets; hamster-blood crystallizes in rhombohedra, and fish blood in fine prismatic needles. The blood of various animals differs, also, in solubility.

Human blood solves very readily; the blood of monkeys, hedge-hogs, and others, solves equally easily. The blood of the guinea-pig, the squirrel, the rat and other rodents, on the contrary, solves with great difficulty. There is also great difference in the sinking capacity of the corpuscles. Horse blood, for example, possesses the greatest sinking power, forming rapidly a layer of blood corpuscles in the serum when collected in a glass vessel. Some blood will crystallize rapidly; another with far greater difficulty. These facts may assist to answer the inquiry as to the identity of human blood.

I have purposely given a more ample description of this blood crystallization, the only crystallizable albumen known, because upon this important knowledge will rest the possibility to understand what follows.

OPTIC RELATIONS OF BLOOD AND ITS CRYSTALS.

When undiluted blood is spectroscopically examined, we observe a dark spectral field, relieved only by a nebulous band in the red part of the spectrum near A. Examine carefully this spectral appearance on the spectroscopic diagram No. 3. The wood-cutter made this line too thick. If we dilute the solution we observe that light between C and D emerges out of darkness. This evolution of light is rapid. If we continue to dilute until the D line emerges from darkness and becomes visible, using, of course, sunlight, we observe the appearance of green light between the lines B and F. Continued dilution favors the expansion of the

green both to the right and to the left of the E line. At this stage we observe a broad black band between the green and the red, which is rather indefinite and blurred in its outlines. Its position is between the lines D and E, and when the solution is now carefully further diluted, we observe the green tint dividing this broad band into two distinct bands. The one near the D line is narrower, but very finely and deeply shaded, and definite in outline, whilst the second, near E, is broader but less deeply black, and rather hazy in its outlines. These are the two bands of Stokes, representing blood in a state of oxidation. We continue to dilute carefully, and the spectrum clears up, at both its extremities permitting all spectral tints to appear in full brilliancy. Further dilution from this point has the effect to contract the bands and make them hazier until finally they disappear altogether. The limit is, however, such, that $\frac{1}{8000}$ part of a grain of blood may yet be spectroscopically demonstrated. Solutions of hæmato-crystalline follow precisely the optic phenomena of blood.

For those who desire to convince themselves of the correctness of the above statement, we would recommend to employ the blood of healthy man or animal, to measure the amount of water necessary, to proceed from step to step, especially the quantity necessary to produce the oxygen blood bands in their full purity. And hereby hang several lessons: First—These peculiar spectral phenomena just described are not produced by any other fluid or substance known; and where they appear in the succession pointed out, we can confidently claim that the presence of blood or of haemato-crystalline has been made out.

Second—We can fairly judge of the blood under examination, whether it is in a normal or abnormal condition, ænæmic or otherwise. Blood deficient in haemato-crystalline will require less water to bring about the above described spectral phenomena. If so, we may be sure that the processes of respiration, oxygenation and oxidation are imperfectly performed, and vitality is at a low ebb. This procedure has, therefore, not only a qualitative, but also a quantitative significance.

Certain precautions, which will be easily understood, are necessary to avoid errors. We must carry on the observations precisely under the same conditions, with the same spectroscope, the same source of illumination, same temperature, the same distance of the glass tube or vessel from the slit, and the same relative width of the slit; in short, says Hoppe-Seyler, "nothing at all must

be changed, except the solution or fluid to be examined." The oxidized blood bands are seen on the diagram No. 1.

DEOXIDIZED OR VENOUS BLOOD.

We have already adverted to the fact that blood may exist in a double state of oxidation. When saturated with oxygen we call it oxidized blood. It corresponds to the arterial blood in the living body. It is also said to be oxyhæmato-crystalline, or oxyhæmoglobine, or oxycrucrine. To this state, we have seen, corresponds No. 1 on the diagram on chart. But the blood can be deprived of its oxygen by mechanical, as well as by chemical, means. We can use the exhausting pump mechanically. Chemically we use such reagents which appropriate the oxygen. These are called reducing agents. Ammonium, sulphate, tin oxidul and others may be used for this purpose. If we observe the spectrum whilst using these agents, we immediately witness a change. "A change has come over the spirit of its dream." The two oxygen-blood bands disappear and make room for a broad dark band occupying the space between D and E. Examine this band on the diagram (it is marked 2.) This band is called the reduction band, also the band of Stokes, who first saw and described it; it may also be called, with great propriety, the band of deoxidized blood.

Blood in a state of deoxidation is still blood, in full integrity and vitality, for all that is necessary to restore its two oxygen bands is to shake the blood up with air, or add some substance that will give up its oxygen to the blood. Solutions of hæmato-crystalline behave in precisely the same manner. This process can be repeated many times with the same results.

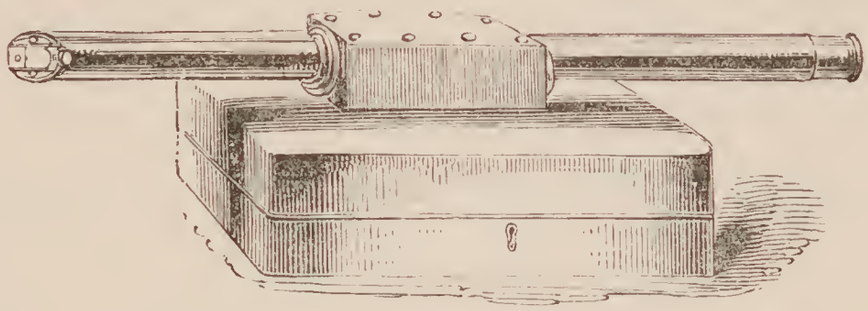
Remember these facts, for they are of the greatest importance in spectrum analysis. Suppose we are called upon to analyze spectroscopically a specimen of blood that has lost this most important qualification; that it cannot be reduced or deoxidized, or that it is in a reduced condition and cannot be made to return to its normal oxidized condition: would you not at once conclude that some powerful chemical agent must have acted upon it and destroyed its physical integrity? Surely such a mode of reasoning would be logical. We shall presently learn that this reasoning rests upon well ascertained facts.

AFFINITY FOR IRRESPIRABLE GASES.

Wonderful as are the functions of the crystalline element of the blood, it possesses other and dangerous qualities whereby

destruction to life is invited and facilitated. They have an exceedingly energetic affinity for irrespirable and poisonous gases, with some of which they enter into close and inseparable combinations, thereby sacrificing their own integrity and life-supporting power forever. Some of these poisonous gases deprive the hæmato-crystalline of the blood of its power to absorb and fix oxygen; others seize and consume all the oxygen of the blood to satisfy their own keen affinity for this gas; others cause a cleavage, a true chemolysis of the blood hæmato-crystalline, combining with its alkaline base, thereby setting this crystallizable substance free, whilst still others cause several of these effects to take place at one and the same time.

When such a fundamental and vital change has taken place, the blood's life function is at an end. Often it is not even necessary that the entire blood mass should have been disintegrated. We understand now how it happens that when a man inhales the poisonous and much dreaded fire-damp, the mephitic exhalation of the coal mines for example, he may be brought to the surface alive,



No. 3. Direct vision Spectroscope.

may linger on for days, and yet be beyond the possibility to recover even when he plunged in an ocean of oxygen. Such was the condition of many of the victims of the accident a few years ago in the collieries of West Pittstone, Pa., for in these cases fatal injury was sustained by the crystallizable albumen of the blood.

And here comes in another practical lesson. When a cleavage, or chymolisis of the blood has taken place, its disintegrated elements become foreign bodies, liable to work out extensive mischief, unless eliminated and carried from the system.

You may naturally ask, Is there no remedy for this condition of affairs?

In answer, let me refer you once more to Preyer's experiments with the dogs, and how rapidly their oxygen was consumed. The safety of the patient must depend often upon the speedy manner the defect is made good. This can be done by transfusion, sending airable blood through the arteries and veins. Perhaps some day we will discover how to utilize the haemato-cryst. solutions for this

purpose. By it, we supply the asphyxiated system with that substance by which oxygen can be carried and respiratory and oxidising functions become possible. These considerations will come up with renewed force when we shall speak of anæsthetics, especially of those that produce insensibility by abstracting the oxygen from the blood and suspending one of the most important of the organic processes, that of respiration. You will now well understand how a fatal result may ensue from such agents, that greedily appropriate the oxygen which the blood may have stored up, and which, in addition, still further destroy the integrity of the same in a manner to paralyze its vital function. I have called your attention already to the fact that we can obtain some of those combinations in a crystalline form, to wit: the prussic acid, the carbonic oxide, and the nitric oxide, haemato-crystalline. These combinations are far more stable and far more difficult to disassociate than the oxyhaemato-crystals.

These changes are faithfully registered in most instances, and we will, farther on, see what great value spectral analysis has in forensic medicine.

PREPARATION AND MOUNTING OF FERNS.

J. D. KING.

THE selection of the fern is all important. It should be of robust growth and free from dirt, for a dirty fern is hard to clean. If not fully ripe the spores will be shrunken and without character; if over ripe, the spores will not be there. If selected from an herbarium, it must not have been poisoned, for poisons will be likely to interfere with staining.

Have in readiness a few wide-mouthed bottles that will hold about an ounce. Morphine bottles are excellent. Carefully select the best pinnae and soak them in a bottle of alcohol and water, half and half, till perfectly saturated; this will give the bleaching fluid a chance to take hold more uniformly. If to be kept some time add one fourth part alcohol to prevent moulding. It is best not to put but one kind in a bottle if wanted for study.

Note;—In all the processes of preparation keep everything perfectly clean, avoid shaking the bottles, and handle carefully with forceps without touching the sori.

For bleaching, the following formula is in common use and is all that can be asked.

Dry chloride of lime,	2 oz.
Soda crystals (washing soda),	3 oz.
Water,	2 pts.

Mix the chloride of lime with half the water, and the soda with the other half,—mix the whole together, and allow to settle in a well corked bottle. Pour off the clear liquid for use, which should be kept in a bottle with glass stopper.

Pour the alcohol and water from the fern and supply its place with bleaching fluid, and place in a strong light if you wish to hasten the process. Look at them often, and as fast as the leaves appear to be bleached examine with a lens, and if there is no remaining appearance of chlorophyll in the sporangia or in the leaf, the bleaching has gone far enough. It is not always safe to wait for a stout midvein to become perfectly clear, for a very little over bleaching may injure or ruin the fern. Some are much harder to bleach than others, and in some cases it may be necessary to change the fluid two or three times.

When the bleaching is completed—discarding all chemicals recommended for the purpose of removing the chlorine,—remove the leaves to a liberal quantity of soft water, which should be changed once in an hour or two, till there is no trace of chlorine remaining; if the chlorine is not all soaked out the staining will be a failure. Remove finally to alcohol for hardening the tissues, which by this time may have become somewhat soft, where they may remain indefinitely if the alcohol is perfectly clean; if not clean, they will be soon ruined.

It should be remembered that it is impossible to give exact formulæ for double staining that will work every time, for staining fluids are not all alike, and other conditions may vary, and something after all must be left to the judgment and skill of the manipulator; the following, therefore, may be accepted rather as the basis of experiment than as exact rules.

For showing epidermal structure, use alum carmine and methyl green, in the proportion of one drop of methyl green to ten drops of alum carmine in a watch glass, measured with a dropper for exactness. There is no rule but experience for time required: it may be an hour, or it may be longer, according to the character of the fern or the depth of stain required. Just the right time will stain the spores, and often the spore cases, a beautiful green and the leaf a fine red; sometimes the larger veins also will take the green, and the entire epidermal system will be shown perfectly. If

they remain too long in the dye the red will drive out the green. Transfer to at least two ounces of water and soak at least three hours to take out the alum, or it will crystallize in the slide. But the ferns seem to differ from each other chemically, and it may be found necessary to vary the formula in some cases to avoid the secondary tint. It will also be found difficult to stain the very thick-leaved ferns by this process without making them too opaque, and for them the next process will be found more satisfactory.

For thick-leaved ferns, or for showing the fibro-vascular system and sporangia:

To forty drops of borax carmine add one drop of methyl green. This requires more time in the dye; indeed, there is little danger of overstaining, for it is hard getting the borax carmine into the substance of the leaf, and at best the color will be very delicate, but if successful the result will be very satisfactory. Soak as before, or the carmine adhering to the surface of the leaf will make trouble in the slide. A saturated solution of acetate of alumina used as a mordant after soaking will brighten the color a trifle.

MOUNTING.

The best medium for mounting ferns is glycerine jelly made after Kaiser's formula, with additional gelatin to give it hardness. Balsam makes a ghostly slide showing little of details, and glycerine requires a very deep cell and is not as satisfactory in any respect; but glycerine jelly is hardest of all to manage, so far as my experience goes, except by the following method.

First transfer to C. P. glycerine and alcohol, half and half, filtered, and do not let the alcohol dry off in making the change; if you do, the air will get into the leaf and ruin it. Next heat the glycerine jelly in a water bath, and keep it hot while using, to prevent trouble from air bubbles. With a glass rod place a few drops on the slide, with or without a cell,—a cell makes the better finish. Place the ferns in the glycerine jelly, add a few drops, and pour off to get rid of the alcohol and glycerine, replace what is poured off and examine with dissecting microscope for air bubbles, which must be removed for they will never leave after the cover is on. Breathe on the cover and apply a drop or two of hot glycerine jelly, then breathe on the slide and apply the cover.

Another way is to let the glycerine jelly harden on the slide with the fern in it, and at your leisure apply a layer of hot glycerine

jelly to the surface and place on the cover as before. In this way wood sections may be arranged and kept in their places. Wood sections may be stained and mounted the same as ferns.

Something more might be said about staining ferns by separate modes, or staining the colors separately, but we will reserve that till another time.

EDGARTOWN, MASS.

THE GERM OF THE SOUTHERN CATTLE PLAGUE.

BY FRANK K. BILLINGS,

DIRECTOR OF THE PATHO-BIOLOGICAL LABORATORY OF THE STATE UNIVERSITY OF NEBRASKA.

IN order to prove that it is the manure of infected cattle which lodges the germs of the Southern cattle plague, we must first find the germs.

Has anybody found them? To which I answer that there has, and that the honor belongs entirely to Nebraska, as well as does that of completely connecting the germ of swine plague with that disease and discovering the true nature of that pest. Detmers saw the germ of swine plague first, but it was left to us to prove its unquestioned connection with that disease. Our discovery of the germ was as original as if it had never been discovered, but in no way detracts from Dr. Detmers' credit as the first discoverer. Salmon, of Washington, deserves credit for nothing except ten years' protracted deception of the American public.

Detmers found a germ in the Southern cattle plague, but it was a large bacillus and had no direct communication with the disease. Salmon found another coccus in this disease also, but it was a double coccus and had no relation to it. These observations will be considered in detail in our full report. How may we know that we have discovered the germ in any specific disease? In order to make such an assertion the following conditions must be fulfilled in every detail:

First.—In the tissues of animals ill with a specific disease must, in each case examined, be found the same germ.

Second.—This germ must be cultivated, free from every other germ, in some of the artificial media.

Third.—It must be shown that the germ in question has pathogenetic (disease producing) qualities by inoculating animals and killing them thereby.

These three conditions have been fulfilled. The germ of the Southern cattle plague has been found in the blood, the gall, the urine, the liver, spleen and kidneys of every animal that we have made an autopsy on that was diseased. These germs have also been cultivated in an absolutely pure form upon and in artificial media. Gophers, or ground squirrels, have been inoculated with such cultivations and died from the effects, and the same germ found in their blood and tissues and in sections made from their organs. Cultivations from the same have also been made, invariably showing the same germ as that got from the cattle.

These results, however, do not show that this was the germ of Southern cattle plague. They only show that a germ was found in the tissues of diseased animals that had fatal disease producing properties.

How, then, can we tell that it is the specific germ of the Southern cattle plague?

To be able to affirm this fact positively cattle must be inoculated, as the ground squirrels were, with unquestionably pure cultivations, and the Southern cattle plague produced in those cattle, and the same germ found in their tissues and cultivated from them. We have done this and can dèmonstrate the entire series of facts by cultures and microscopic specimens of the tissues.

Hence the germ of the Southern cattle plague has been found, and I think I may be pardoned in claiming *this to be the first occasion in the history of American medicine that not only one, but two germ-diseases of animal life have been thoroughly traced out and placed upon an impregnable scientific basis.*

The sun of original investigation seems to be rising in the west so far as America is concerned.

This honor belongs to Nebraska, and the credit of it is equally to be shared by the State board of agriculture that suggested the work, and the board of regents of the State University who have made the work possible. I challenge the world to show more creditable work done by the most noted European investigators within the period of fourteen months in the history of medicine, without more than alluding to the many disadvantages under which the work had to be done for want of proper resources, material and means, especially up to the present time, in comparison to the advantages which the European governments offer their workers. These remarks are not offered in complaint. Such stations as this are gradual growths.

We have made a magnificent beginning and shall surely arrive at the fullest measure of completion. As has often been said, Nebraska has the credit of being the first State in the Union to establish an institution of this kind, and the results have certainly been such that every patriotic citizen of the State can point to them with pride.

AN ALCOHOLIC ALUM-CARMINE STAIN.

W. C. BORDEN, M. D., U. S. A.

THE efficacy of the alum-carmine fluids in tissue-staining is well known. With them the nuclei of cells are shown purple, sharply defined, with clear details, and other elements are slightly, but clearly stained of a lighter color. They are made by boiling either carmine or cochineal in an aqueous solution of alum, and are preserved by the addition of carbolic acid or chloral hydrate. Of the two methods, the one in which cochineal is used, in my experience, gives the better results, but both are open to some objections. First, as the stain is in aqueous solution, it is apt to precipitate in the tissues, when alcohol is used either before or after the application of the stain, unless the alcohol be entirely removed before the stain is applied, or unless, after staining, the superfluous stain be washed out, by rather prolonged soaking of the tissue in water, before the application of alcohol. This is especially true if the staining be done in bulk, and the larger the piece to be stained, the longer it will take to remove the surplus stain. Second, the stain is an excellent one for staining in mass, and as the tissue to be stained must remain for some time in the fluid to allow thorough penetration of the stain, often for a week or more if the piece is large, or if the hardening has been done in a bichromate of potash or acid fluid, this long immersion in an aqueous fluid is not desirable. Third, for tissues hardened in potassium bichromate, or acid fluids, the action of the stain is rather slow, even when the staining is done after sectioning.

For these reasons I determined to attempt an alum-carmine stain, in which alcohol should enter largely; and, after various attempts, settled upon the following as giving the best results:

Cochineal (whole insects)	1 dram.
Saturated solution of alum	4 ounces.
95 per cent. alcohol	4 ounces.

Pulverize the cochineal by grinding in a mortar, add the saturated solution of alum and boil fifteen minutes, adding distilled

water occasionally during the boiling, to make up for the water lost by evaporation. Cool, and pour without filtering into a ten-ounce or larger bottle. Add the alcohol and let stand with occasional shaking, for forty-eight hours. Filter and preserve in close stoppered bottle. Carmine, thirty grains, can be used, if desired, in place of the cochineal, and gives a nearly identical stain. There is, however, no advantage in its use, and the cochineal is cheaper.

The stain made as above is a perfectly clear, purplish-red fluid, and is superior to any aqueous alum-carmine stain in the clearness and brilliancy of the coloring which it imparts to the tissues. It will keep indefinitely, but a slight precipitate sometimes forms, which should be filtered out. This does not indicate any decomposition of the stain, nor does it alter its staining character in any respect. The following stain, made with carmine and without heat, will give a fluid nearly identical with the first, except that no precipitate ever occurs, however long it is kept:

Carmine	30 grains.
Alum	4 drams.
Distilled water	4 ounces.
95 per cent. alcohol	4 ounces.

Grind the carmine and alum together in a mortar, gradually adding the water. Add the alcohol, and pour without filtering into a ten-ounce bottle, cork tightly and let stand for a week, shaking occasionally. Filter, and preserve in a close-stoppered bottle. When these fluids are used for staining in bulk, pieces of tissue can be transferred directly to them from the strong alcohol in which they have been preserved, to remain from two days to as many weeks, according to the size of the piece and the previous treatment of the tissue. Tissues hardened in alcohol, or corrosive sublimate and alcohol, stain much more rapidly than those hardened in Muller's fluid or chromic acid. In all cases in which a fluid for hardening other than alcohol is used, it should be entirely removed from the tissue by repeated changes of alcohol, before the stain is applied. In fact, this should always be done, *whatever* stain is to be employed, and whether the staining is to be done in bulk, or after sectioning. Overstaining need not be feared with any of the alum-carmine fluids, and the tissue should always remain in the fluid long enough to ensure the penetration of the stain to every part. The length of time required for different tissues can only be learned by experience, but to begin with, it is better to err on the side of leaving the piece in the stain too long, than the reverse.

Staining *in toto* offers the advantage of great saving of time when a large number of sections are to be made and mounted, and for serial sections, where the relation of cells and parts are to be studied rather than cell-structure, it is undoubtedly superior to the method of staining each section separately; but when cell-structure is to be observed, or only a few slides are to be made, the method of staining each section separately is, in general, better, as the staining is under more perfect control. When the paraffin or celloidin methods are used, the best way, when staining each section separately, is to immerse the sections cemented to the slides, in the stain, contained in a beaker, or wide-mouthed bottle.

The slides can be removed and the sections examined from time to time, to note the progress of the staining. The stains are quite powerful, and act upon tissues hardened in Müller's fluid or chromic acid quite quickly, much more rapidly, in my experience, than borax carmine, and about as quickly as Kleinenberg's hæmatoxylin. They give excellent results in photo-micrography by lamp-light, owing to the sharp nuclear definition and slight staining of the other tissue elements. I have never used them in photographing by sunlight, but have no doubt they will work as well by it as when a lamp is used.

FORT DOUGLAS, Utah.

PROCEEDINGS OF SOCIETIES.

SAN FRANCISCO MICROSCOPICAL SOCIETY.

THE regular meeting of this Society was held November 9th, and was well attended; President Ferrer in the chair, and C. P. Bates Secretary *pro tem.*

A sample of Mono lake water was handed in by Dr. Mouser and was referred to Mr. Payzant for determination of crustaceans living in it.

The paper of the evening was by Mr. Henry G. Hanks, of San Francisco, concerning California rock salt, as follows:

Some months ago I received some fine specimens of rock salt from Mr. J. S. Cook, of San Bernardino county, which I found very interesting, and at the same time I was impressed with the importance of such salt to our State and to the Pacific coast. But press of other business caused me to lay the matter aside for future consideration. Lately my attention has again been called to this very inter-

esting subject, and I have discovered certain peculiarities in the mineral that I trust will be as interesting to the members of this society as they have proved to me.

Like the very best quality of rock salt, this mineral occurs in blocks of the utmost transparency. It is quite easy to read printing through a cube several inches in thickness. Some pieces are as clear, colorless and free from mechanical impurities as ice from distilled water, frozen in a vessel of porcelain. Others contain some foreign matter which does not enter into the composition of the salt. When dissolved and filtered the solution is perfectly colorless, and on applying the usual chemical tests, without observing sufficient care to detect minute traces, the salt is found to be almost absolutely pure. The fact that in a somewhat moist atmosphere it does not deliquesce is an additional proof of its chemical purity.

Some pieces, transparent and colorless, melt at a red heat on platinum foil without decrepitation to a transparent and also colorless fluid, which retains its transparency when cooled.

Other specimens show faintly opalescent lines meeting each other at right angles. If such a specimen is held at a certain angle in the sunlight, a multitude of reflecting surfaces like imbedded spangles may be seen which glimmer something like adventurine, or glow like a sunstone. It may also be seen that while the faint lines meet at right angles, a dividing line forms a miter like the corner of a door panel. Such a specimen, when heated to redness, explodes with great violence, so much so that the experiment is one of considerable danger if the eyes are not protected from the minute flying cubes into which the larger one is broken by the explosion.

On obtaining these very interesting results, I naturally appealed to the microscope, our favorite instrument, for the cause of the violent decrepitation in one case, and quiet fusion in the other. Nor did I seek in vain, as I hope to be able to show you this evening. I found the phantom lines and reflecting spangles to be minute cavities in the anhydrous salt, all of the same general form, but varying in size from those so minute as to be scarcely visible under a two-thirds objective, to others that can be examined in detail. The cavities are box-shaped, mostly square but sometimes slightly oblong. They are generally from four to six times as broad as they are deep. All the angles are rounded, and all the lines marking the sides of the cavities curved just as we saw others some months ago while examining the beautiful diamond from Amador. Both these minerals crystallize in the same system.

All the imbedded cavities are empty. You may search them over and not see a particle of inclosed matter. But on the surface, where the walls are broken down, they may be seen partly filled with the debris of the crushed salt, which proves that they are actually cavities and not illusory.

It having been proved that the salt contains only traces of water, it may be inferred that the cavities are filled with a gas or with atmospheric air. Otherwise it would be difficult to account for the explosion when heated.

On examining the salt after heating, it was found that the transparency was not materially impaired except at those points where the box-like cavities were shattered by the escaping air under pressure. They had lost their beautiful form and had become irregular, roughly globular cavities, filled with broken fragments of salt. In every direction from the shattered cavities the substance was fissured and fractured, showing the great force exerted by the escaping gas or air. It is a mystery how these beautiful cavities could be formed in so hard and anhydrous a substance as rock salt.

After actual food and water, salt is one of the most necessary requirements of man and animals, and it is a question if a healthy bodily condition could be long maintained without it. Salt is also largely employed in manufactures and the arts.

Rock salt is not always so pure as the specimens shown you this evening. In England it is colored red by the oxide of iron it contains. It is also sometimes contaminated by clay and sand, and often by imbedded associate minerals, as gypsum, anhydrite, borax, glauberite and others; still it is seldom, if ever, so impure as salt made from seawater, for which reason it commands a higher price. It dissolves more slowly than the more impure varieties, which property fits it for certain purposes and uses in the arts. Pure salt does not deliquesce except in a very moist atmosphere.

Salt obtained artificially contains various impurities which impair its value. These impurities are generally magnesia, gypsum, bromine and iodine, with much organic matter, while rock salt is free from them. This has led to the theory that seawater takes its salt from beds of rock salt, instead of rock salt being deposited from the ocean. This theory is strengthened by the fact that rock salt is sometimes absolutely anhydrous.

While inferior salt may be extracted from brines found in nearly all countries, rock salt is rather rare. It occurs in very large deposits in England, Poland, Hungary and Germany. In the high mountains of Chili it is met with at an elevation of 9000 feet above

the sea level. In Spain, 16 leagues from Barcelona, there is a mountain of salt three miles in circumference and 500 feet high. It is quite pure. No gypsum is found with it. This mineral has been found also in considerable quantities in New South Wales.

It has long been known that rock salt existed in very large quantities in Nevada and Arizona. On Holt's map of Calfornia and Nevada, published in 1876 a deposit in Lincoln county, Nevada, is described as being five miles long and 600 feet high. This locality lies 53 miles, by the scale of the map, a little west or north from Callville, on the great bend of the Colorado River. Some years ago I examined specimens and found them to be very pure.

In Cleveland's "Mineralogy," published in 1816, I find a statement that "rock salt is found in California in very solid masses." The writer probably referred to the peninsula of Lower California.

In the sink of the Colorado desert in San Diego county, deposits of salt have been discovered, and are rather extensively worked, but this salt is probably the result of the evaporation of the waters of an ancient inland sea, cut off from the great ocean by the delta of the Colorado River, or by an upheaval of land, gradual or otherwise. The water, under the influence of the sun and the dry climate of the locality, became less, until a resulting small lake of concentrated seawater finally dried and left the deposit of salt. This is a good theory until a more thorough study of the deposit is made. It is now covered by silt and debris washed down over it during many winters of rain-storm and cloud-burst.

The associate minerals often found with rock salt have also great value. Chloride of potassium in very large quantities is extracted from beds overlying the salt deposits at Stassfurt, in Saxony. Some idea of the quantity may be inferred when the statement is made that in 1863–64, 400 tons of *carnallite* were raised. The yield increased annually until 1875, when the production was 494,414 tons. *Carnallite* contains theoretically 26.88 per cent. of chloride of potassium.

If a deposit of this character should be discovered in connection with one of our great salt deposits, its importance to California and the Pacific Coast can scarcely be estimated.

Mr. Hanks illustrated his essay with specimens which were examined under the microscope, and found to bear out well the descriptions in the paper. The study of the specimens led to an interesting discussion of the subject.

EDWARD J. WICKSON,
Recording Secretary.

EDITORIAL.

PHOTO-MICROGRAPHY.

IN looking over the literature of photo-micrography, we have been struck with the paucity of articles written on this subject for beginners. Extensive and valuable communications on the use of the amplifier, and other parts and accessories, and numerous descriptions of cameras and holders have appeared, but during 1887, almost nothing new, in the microscopical journals at least, has been written on the methods of work, the value of different developers, and the minutiæ of technique. In photo-micrography, as in microscopy, workers are constantly running onto helpful devices and methods which should be written up and published for the general good, and not held secret for individual benefit.

The late Dr. Woodward, probably succeeded better in photo-micrography than any other individual who ever worked in this department, and it was his constant aim to give out his knowledge as soon as acquired, so that his mantle has fallen onto the shoulders of thousands all over the world.

Excellent work is being done in this country, and many of our microscopists have already achieved great fame in this line. We cannot but regret, however, that so little has been published as to methods, during the past year, and earnestly urge all who are interested to do their utmost to advance photo-micrography during 1888.

THE Microscopical Society, of Calcutta, India, mention of which was made in a recent issue of this journal, have issued a "Prospectus and Rules," and "By-Laws and List of Members,"—two neat pamphlets which speak well for the society. Mr. W. J. Simmons, the Honorary Secretary and originator of the society, in a communication to us under date of November 26, 1887, makes the following kindly reference to the other leading members of the council:

"** We could have made no way had it not been for our Vice-President, Mr. Wood Mason, who has entered so fully into the spirit of the society that he is our main stay. He is curator of the Indian Museum here, and a lecturer on zoology at our medical college. His influence in scientific circles here is deservedly great. He lets us meet in the Biological Laboratory of the museum for our council meetings, and has secured us a nice room in the main building of the museum for our monthly general meetings. His zeal is untiring,

and I have little doubt that under his leadership we shall make great way yet. Dr. Simpson, the President, also possesses much influence. He is Health-Officer here, and has in that capacity, both before and since he took up the duties of his office, attracted attention not only in England, but on the Continent. He is a capital microscopist, and imbued with no end of energy in the interests of our society." We feel sure that the Calcutta Microscopical Society will exert a positive influence on Indian science, and we wish it the success which it deserves and is sure to win.

WE DESIRE to call attention to the valuable articles on the spectroscope and its application to medical practice, commenced in our last number. We are giving rather more space to this contribution than is our custom, but we feel sure that our readers will appreciate Dr. Waterman's careful consideration of this important subject, and although many other articles are crowded over to another month, in consequence of the space occupied, we so rarely have an opportunity to publish anything on spectroscopy from so distinguished a source, that we feel sure the omission of other matters will be gladly ignored.

ACKNOWLEDGMENTS.—From Wm. J. Morgan, Somerville, Mass., photo-micrographs of formation on lobster bone; from Rev. J. D. King, Edgartown, Mass., mounts of black-oak stem, bugula flavella, sponge, sycotypus cannaliculatus; from E. S. Coutant, mount of female long-scale insect.

TECHNOLOGY.

MAYER'S CARMINE.—This staining-fluid (*Am. Naturalist*), previously described as "alcohol carmine," is a modification of Grenacher's acid carmine.

Carmine	4 grams.
Water	15 c. cm.
Hydro-chloric acid	30 drops.
Alcohol (8 %)	95 c. cm.
Ammonia (enough to neutralize).	

The pulverized carmine is mixed with the water and the acid, and dissolved by boiling; the alcohol is then added, and the solution neutralized by stirring in ammonia until a precipitate begins to appear. This method of procedure is safer than the one hitherto followed, according to which the carmine was dissolved by boiling in the alcohol plus the acid.

EMBEDDING PLANT TISSUES.—Dr. E. Schönland, of the University of Oxford, claims to have reached the long-desired process of embedding delicate plant-tissues in paraffin, so that unshrunken serial sections may be cut by the ribbon method. His process is described essentially as follows in the *Botanisches Centralblatt*, vol. xxx, (1887) p. 284: The object should be stained entire in borax-carmine, for which twenty-four hours suffices; then place it in 30 per-cent. alcohol, to which a trace of acetic acid has been added, and then in successively stronger alcohol, up to the strongest commercial, which is 92–95 per cent.; it is next transferred carefully to a small vial (containing 3–4 cm.) of equal parts of clove-oil and strong alcohol; at first it will float, but when it has sunk to the bottom, which often takes some time, it should be transferred to pure clove-oil, and after an hour into oil of turpentine, in which it must remain about six hours. Finally it is placed in melted paraffin for 8–10 hours. The paraffin used must have a melting-point of about 45° C., and its temperature must never go above 47°; for keeping the temperature constant, the well-known thermo-regulator must be used. The embedding is done in the usual manner, using either the paper-tray, or the L-shaped pieces of metal. It is generally best to raise the temperature of the paraffin somewhat shortly before pouring it into the mold, to prevent the formation of bubbles on cooling. The manipulations for cutting the ribbons of sections with the rocking or sliding microtome are the same as with animal tissues. The sections are fastened to the slide with a mixture of one part of collodion and three parts of clove-oil, or a mixture of filtered white of egg and glycerine. The first is preferable in case one desires to stain the sections on the slide, while the latter is generally reliable when the fixing only is desired. The slide is then put in a warm place for a short time, or warmed gently over a flame, then plunged into turpentine or flooded with it to dissolve the paraffin. It is then ready for staining or mounting in the usual way. * * * The author adds that the results which can be attained are almost incredible. In serial sections of leaves one can, not infrequently, get four to six sections through the same stoma, and it is easy to get several sections through the apical cell of a fern root, when the embedding is rightly done. * * *—*Botanical Gazette.*

ABSTRACTS.

THE CONTEST BETWEEN LIVING ORGANISMS AND BACTERIA.

PROF. Metschinkoff recently published in the *Annales de l'Institute Pasteur* a very interesting study on the fight which is carried on in living organisms between bacteria and similar beings brought from without and the cells of living organisms — cells which he calls *phagocytes*, and are of two orders : the *leucocytes*, or white blood-corpuscles, and the conjunctive cells, which are similar to the preceding, except that they do not move about, but keep always quiet. This fight Metschinkoff has witnessed for the first time on some daphina, small, fresh-water crustaceans, which are subject to become victims to a *monospora*, a fungus of inferior order. As soon as a monospora invades a daphina, the leucocytes swarm around it, surround it, and destroy it by a process of intracellular digestion. In eighty per cent. of the cases the leucocytes are successful, and entirely kill the monospora; in twenty per cent. the monospora gets the best of them, and the daphina perishes, being unable to sustain the fight. In all cases of parasitic disease, the result of the organism depends upon the result of this fight, which occurs more or less in all cases, from man downwards. In some rare cases, there is no fight; for instance, in cases of *cholera des poules* the bacteria multiply and grow freely without any show of fight on the part of the phagocytes of the hen; in the guinea-pig, on the contrary, the phagocytes work in a very energetic manner, and the consequence is, that they generally succeed in destroying the bacteria, and the guinea-pig is saved. In some cases, such as that of *charbon*, caused by *bacillus anthracis*, the leucocytes take no part at all in the fight, and it is only the phagocytes of the spleen which do something; but they are not numerous enough, and are nearly always defeated. When an *attenuated* virus of *bacillus anthracis* is locally injected, on the contrary, the leucocytes fight well, and it is easy to see within their envelope a number of dead bacilli.

In order to ascertain whether this fight between parasitic fungi and the phagocytes of the body is a regular circumstance, notwithstanding some exceptions, Professor Metschinkoff has extended his investigations to a great number of parasitic diseases; and he has seen that the fight takes place in erysipelas, in malarial fever, in typhus-fever, and other diseases. In other cases it also takes place,

but without any very marked result; because, although the phagocytes do take the fungi into the interior of their cell, they cannot digest or destroy them, on account of the thickness and vitality of the exterior membrane of the fungi. Such is the case, for instance, with tubercular or leprous bacilli. The fight between phagocytes and fungi is, therefore, a common phenomenon, the differences in the result of it being due to the fact that it is not always successful, and that it does not always begin soon enough. Professor Metschinkoff draws an interesting parallel between the inflammatory reaction in warm-blooded animals, which consists in a migration of leucocytes out of the blood-vessels, and the reaction which takes place in animals which are deprived of blood, or of cold blood, in which there also occurs a migration of phagocytes. In both cases the phagocytes surround the foreign bodies and try to destroy them. The process is quite similar to that which obtains in sponges for digestive purposes; all foreign bodies, whether alimentary or not, are soon surrounded by amæboid cells, which are real phagocytes. This very interesting theory of Metschinkoff throws an entirely new light on a difficult question—that of the *modus agendi* of parasitic fungi—and completes Pasteur's theories on that point, showing that parasitic diseases are merely the result of intercellular warfare going on between cellular fungi and elementary cells, very similar in many points to ambæas and such organisms.—*Pop. Sc. News.*

NEWS AND NOTES.

A microscopical society has been organized in Cincinnati.

THE enterprising publisher of *Science*, and *The Swiss Cross* has undertaken a new monthly called *The Puzzler*. It is entirely devoted to games of skill.

THE *American Naturalist* will hereafter be published by the Leonard Scott Publication Co., of Philadelphia. We are glad to notice that the *Naturalist* will drop its sombre brown cover, and hereafter wear a light blue color—not unlike that adopted by THE MICROSCOPE.

IN an exhaustive paper upon methods of measuring thin films, Otto Wiener makes certain measurements of the thickness of a film of silver which can just be perceived by the eye, and arrives at the conclusion that 0.2 millionths of a millimeter is an upper limit of the diameter of a silver molecule.—*Scientific American.*

BOOK REVIEWS.

INTRODUCTORY STEPS IN SCIENCE, VII parts in 2 vols. By Paul Bert, Member of the Institute, France. Translated by Marc F. Vallette, LL.D. and revised and enlarged by John Mickleborough, Ph. D. New York, D. Appleton & Co.

These little books, for use in schools and the instruction of children, comprise seven parts as follows: I. Animals; II. Plants; III. Minerals and Rock Formations; IV. Physics; V. Chemistry; VI. Animal Physiology; VII. Vegetable Physiolgy. The language is simple, though comprehensive; and, though the subjects are dealt with in a general way, enough is told to give one correct ideas. The translator has followed the text of M. Bert very closely, with the exception of substituting some American examples in the place of foreign ones, making it more suitable for use in this country. The books are profusely and well illustrated and are certainly worthy of the wide circulation here that they have attained in France.

ON A NEW TREATMENT OF CHRONIC METRITIS, AND ESPECIALLY OF ENDOMETRITIS, WITH INTRA-UTERINE GALVANISM. By Dr. George Apostoli. George S. Davis, Detroit, 1888, pp. 120.

This translation of Apostoli's pamphlet, will be welcomed by all specialists in this line of practice, and will be found of value to the general practitioner who is sufficiently experienced in the use of electricity, and supplied with the necessary apparatus.

SCIENCE SKETCHES. By David Starr Jordan. Chicago, A. C. McClurg & Co., 1888, pp. 276.

This is the most delightful collection of essays on science topics that has appeared for many years. There is nothing dull or prosy in what Dr. Jordan writes, and this book contains the best of his papers contributed to periodical literature during the past twelve years, besides several addresses which have not before been in print. The essay on Darwin is an honest and appreciative estimate of that great man's life and work, and is the best which has yet come to our notice; while the papers on the Salmonidæ, Johnny Darters, &c. are full of information and interest. As a a truly enjoyable book we recommend this.

BITS OF KNOWLEDGE. John B. Alden, Bavaria to Beer.

ABSTRACT OF PROCEEDINGS OF MICHIGAN STATE BOARD OF HEALTH, AND REPRINTS.

THE INTESTINAL DISEASES OF INFANCY AND CHILDHOOD, by A. Jacobi, M. D. The Physician's Leisure Library. Detroit: Geo. S. Davis.

This is one of the most valuable numbers of this excellent series. Every physician who has much to do with the diseases of

children, fully appreciates Dr. Jacobi's statement in the preface of the book that "of all the fatal affections that come in the first year of life, forty per cent. are diseases of the digestive organs." The ignorance which prevails concerning the proper feeding of children is deplorable and is productive of many of the fatal diseases. Considering the value of its contents, this is one of the cheapest books ever published.

YEAR-BOOK OF PHARMACY FOR 1887, with the transactions of the British Pharmaceutical Conference. T. and A. Churchill, London.

These year-books, prepared under the supervision of the British Pharmaceutical Conference, are very valuable as being careful records of the progress of pharmacy and tributary sciences. The present volume is, like its predecessors, filled with interesting facts so arranged as to be attractive to others than pharmacists.

CORRESPONDENCE AND QUERIES.

F. H. C., ST. JOSEPH, MO.—To become a member of the American Society of Microscopists, it will be necessary for you to attend a meeting of the Society, and be elected by ballot.

D. A. N., NEW YORK.—We know of no professional mounter of insects in this country. Mr. B. T. Quimby, of Chicago, makes the finest preparations of this class which we have seen.

ROTIFER, NEW YORK.—We do not know of any work of the kind for America. Hudson & Gosse's work is what you want. The pages of THE MICROSCOPE contain articles on this subject from time to time.

F. T. B., NEW YORK.—We have published nothing, as yet, on the subject you refer to, but hope to have a paper in due time.

DR. W., KALAMAZOO.—The trouble with the specimen is, it is not properly infiltrated and embedded. Place your specimens for a few hours in absolute alcohol, or in a large quantity of 95 per cent. alcohol; then for an hour or two in *Squibb's* chloroform, and finally in a watch-glass of chloroform and paraffin chips, and keep at the paraffin melting point for about twelve hours. This can best be accomplished in an incubator. Then embed in paraffin, taking care that this is not too hot. If air-bubbles form about the specimen, displace them with a hot needle before the paraffin hardens. The imperfect infiltration, and air-bubbles about your specimen, is the cause of the tearing of the sections.

EXCHANGES.

This department is for the benefit of SUBSCRIBERS *who have microscopical apparatus, material or books which they wish to exchange, and such wants will be* INSERTED FREE OF CHARGE. *The number of insertions given will depend upon the number of exchanges received each month. Subscribers will please notify us when articles have been exchanged or sold. Dealers are referred to our advertising department.*

WANTED—Parasites and books on Parasites and other micro-subjects; will give Anatomical, Pathological, Botanical, Microfungi, Zoophytes, Polycistina, Foraminifera, Parasites, and other slides in return. Shall be glad to open an exchange at any time with micro-correspondents for any of the above subjects.
FRED. LEE-CARTER, Gosforth, near Newcastle on Lyne, England.

FOR SALE—A Bausch & Lomb Model Microscope, with 1 in. and ¼ in. objectives.
W. H. OSBORNE, Chardon, O.

I HAVE a good "Little Monitor" local telegraph sounder and straight lever key (cost new, about $6 to $8), both in good order; also, a Wirt fountain pen (one of the best made, cost $2.50, good as new, having been used but very little; one copy, in cloth, of "Parson's Handbook of Business and Social Forms," 500 pages, $3.50; never used. I wish in exchange, latest editions of Beale's "How to use the Microscope," "The Microscopist," by J. H. Wythe: Rev. W. W. Spicer's translation of Johann Nave's "Handbook of Collection, Preparation, etc., of Algæ, Diatoms, etc.," or other microscopical works. Correspondence solicited. F. W. DUNNING, 32 So. Division St., Battle Creek, Mich.

WILL EXCHANGE—Cabinet specimens of gypsum, specular, micaceous, massive and earthy hematite, slides of diatoms, and literary and scientific works, for well mounted slides, tubes of cleaned diatoms, and standard books on microscopy.
A. F. BARNARD, Box 152, Oberlin, Ohio.

FOR SALE—Powell & Lealand No. 3 Microscope stand, with three eye-pieces and several accessories. Address, A. L. WOODWARD, 53 Lansing St., Utica, N. Y.

BONE and fruit-stone sections for good, medium-angle objectives, 1-5 to 1 inch.
A. E. WARREN, Rio Vista, Virginia.

WANTED TO PURCHASE—*American Journal of Microscopy*, Vol. I, 1876, No. 8. Vol. III, 1878, No. 2. *American Monthly Microscopical Journal*, Vol. VII, 1886, No. 11.
C. C. MELLOR, 77 Fifth Ave., Pittsburgh, Pa.

MR. EDITOR—Will you allow me to say, through the medium of your pages, to the numerous correspondents who have written me in reply to my notice in your Exchange Column, that I exhausted my stock of slides of salicine and urinary deposits within a few days after the appearance of the notice, and that my ever-increasing duties as editor and physician have thus far given me no opportunity to make any fresh ones. Whenever I can get a few hours of leisure I shall make enough to supply all those who have written me, and will give immediate notice thereof in THE MICROSCOPE.
FRANK L. JAMES, M.D., Box 568, St. Louis, Mo.

WANTED TO EXCHANGE—Six complete volumes of *The American Monthly Microscopical Journal*—Vols. I, II, III, IV, V. VI, for first-class diatoms or double-stained plant sections. Correspondence solicited. Address,
W. H. CURTIS, Box 66, Haverhill, Mass.

FIRST-CLASS HISTOLOGICAL AND PATHOLOGICAL MOUNTS in exchange for instruments or books on Microscopy.
A. J. C. SAUNIER, M. D., 92 Laflin St., Chicago, Ill.

WANTED—Nos. 1, 2, 3 and 5 of Vol. I of THE MICROSCOPE—25c each paid. Address this office.

FOR SALE OR EXCHANGE—Mounted urinary sediments, pathological specimens, photo-micrographs, anatomical and pathological material, for mounted slides or photomicrographs on medical subjects. E. L. SMITH, Bellefontaine, Ohio.

FOR SALE—A fine Beck's Ideal 1-6 objective, adjustable, unused and perfect; corrections excellent. Beck's list price, $30; will sell for $20, or will exchange for a new first-class 1-2 or 4-10 inch objective. D. HUMPHREY, Lawrence, Mass.

MOUNTS OF FŒTAL (5 MONTHS) LUNG, section across entire lobe, 1-2000 in. thick, beautifully stained, in exchange for first-class Pathological Slides.
W. C. BORDEN, M. D., U. S. A., Fort Douglas, Utah.

HISTOLOGICAL, PATHOLOGICAL AND MISCELLANEOUS MOUNTS for exchange by H. W. WESTOVER, M. D., St. Joseph, Mo.

THE MICROSCOPE.

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No receipt will be sent for subscriptions received unless specially requested.

Specimens for examination should be sent to the *Microscope Laboratory*, 25 Washington Avenue, Detroit, Mich. In all cases the transportation charges on these specimens must be prepaid, and special directions for packing and shipping will gladly be sent upon application.

VOL. VIII. DETROIT, APRIL, 1888. No. 4

ORIGINAL COMMUNICATIONS.

RECENTLY-DISCOVERED MICROSCOPES OF HISTORIC INTEREST.

JACOB F. HENRICI.

THE first microscope described below was found among a lot of old books and miscellaneous rubbish in a store-room in the village of Economy, Pennsylvania, the residence of the Harmony Society, a communistic society which came to America from Wurtemburg, Germany, in the years 1803–5. Having adopted celibacy, and having received but few accessions for many years, the society has dwindled in numbers from about one thousand to fewer than forty members, most of whom are very aged, and could give no account of the microscope, except that they thought it formerly belonged to Frederick Rapp, one of the early members of the community, who died in 1834.* The instrument was exhibited at the annual reception of the Iron City Microscopical Society, in 1886, and more recently at the annual meeting of the American Society of Microscopists in Pittsburg.

In a drawer in the base of the stand were found four objectives, together with six extra lenses, making ten in all, of which eight are bi-convex, and the other two plano-convex, yielding a magnifying power of 85 to 250 diameters; a brass slide, from which the cover-glasses, as thick as common window-glass, may be withdrawn by removing a brass cap on the end of the slide, thus permitting objects

* Nordhoff: The Communistic Societies of the United States.

to be placed within four circular perforations in a piece of pasteboard forming the centre of the slide; and a brass fish-plate, an almost invariable accompaniment of microscopes of the last century, which was used for confining a small fish, in order to exhibit the circulation of the blood in its tail.

To the bottom of the drawer is affixed a paper, on which is written, in a neat hand, the following inscription, with difficulty decipherable:

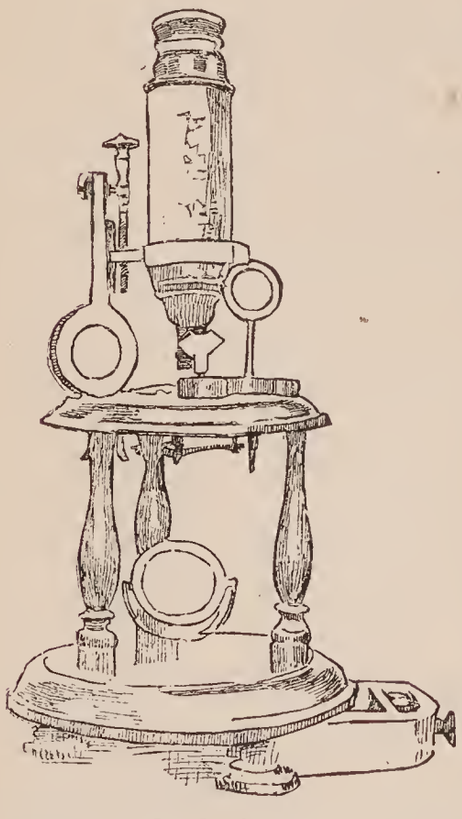
Audax Japeti genus
Ignem fraude malâ gentibus intulit
Nil mortalibus arduum

—Hor. Carm. Lib. I. 3.

In perpetuam memoriam consuetudinis quam cum dulcissimo suo sodali Carolus Linné Parisiis habebat hoc ab eo amicitiæ donum accepit Mense Augusto MDCCXXXVIII.

BERNARDUS JUSSIEU.

The instrument stands sixteen inches high, and can be extended by means of a draw-tube. The stand is of wood. The body-tube, of pasteboard, ornamented with embossed paper, is clamped near its lower extremity to a horizontal brass bar, which is fixed at its opposite end to a grooved plate sliding upon a vertical brass post, focusing being effected by means of a screw, a modification of the form introduced by Marshall, about 1704.*

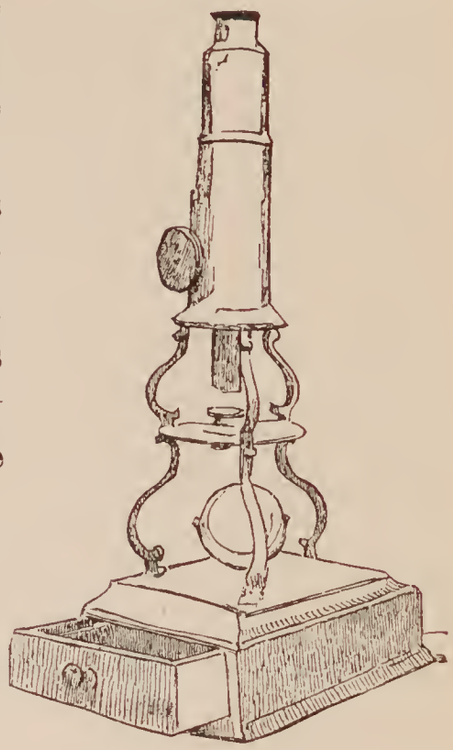


The accessories, in addition to those already described, are a double mirror beneath the stage, one face being slightly concave and the other plane; a holder for a "bulls-eye" condensing lens, from which the lens has disappeared; and a circular ebony disk, mounted on the end of a brass rod, one of the faces of the disk being inlaid with ivory, the object of this device apparently being, as described in old works on the microscope, to exhibit opaque objects; "light colored ones are to be stuck on the dark side, and *vice versa*."

* Mayall: Cantor Lectures on the Microscope.

A fragment remains of a wooden arm, one end of which was keyed to the outer rim of the stage, the other free end having the form of the segment of a circle, and having apparently contained originally, at equal distances along the segment, some eight circular perforations, in which objects could be enclosed between glass or mica covers, so that when the arm was moved the objects would pass in succession beneath the objective.

I have recently found, in the same village and under similar circumstances, another microscope, of the Culpeper type, being the exact counterpart, in every particular, of one figured in Plate IV of Adams's "Essays on the Microscope,"* except that the present one has the addition of a rack and pinion for focusing, a decided improvement, though the rack and pinion movement of this instrument is not nearly so satisfactory as that of the screw in the older one described above.



The accessories to this microscope are precisely as described by Adams, even to the five "ivory sliders with objects," each "slider" containing four objects, one having fish-scales, another vegetable sections, a third animal parasites, the fourth parts of plants, and the fifth various objects. These are mounted dry between thin plates of mica, secured by sprung rings of brass.

A search in the same locality for early microscopical literature has proved fruitless.

ECONOMY, PENN.

NOTE ON A FASOLDT TEST-PLATE.

From remarks by R. H. Ward, M. D., at the Pittsburg meeting of the American Society of Microscopists, Sept. 2, 1887.

THE plate consists of 23 bands ruled on a cover-glass, beginning at 5,000 lines to the inch and increasing by 5,000 each time to 30,000, and thence by 10,000 each time to or toward 200,000. The lines are ruled alternately longer and shorter, so that the 40,000 band becomes at each end a 20,000 band with interlying lines,

* Essays on the Microscope, by George Adams, London, 1787.

and the "200,000" band should be seen, if resolved at all, as a 100,000 band similarly interlined. The extraordinary mechanical skill of the maker and his success in ruling the lower bands attach real interest to the plate, and to his methods of studying it, in respect of the possibilities of fine ruling and of extreme resolution; an interest which is enhanced rather than diminished by the maker's easy faith in the character and visibility of the highest bands and his inability to apprehend the mechanical uncertainties and scientific absurdities involved in this belief. If he has done even a small portion of what he thinks, he has far surpassed all other experimenters, as far as yet proved, and has earned and will receive the credit that he claims.

Upon learning of the appointment of the committee, Mr. Fasoldt tendered a request that he might be allowed to be present "when the plate was examined," and kindly offered the use of his apparatus, and also of his own services, to "show the lines" to the committee at any time. Believing it to be of scientific as well as historic interest and importance to know exactly what he saw and how he saw it, I replied that while it would be impracticable for the committee as a whole to make the proposed arrangement, as a member of the committee I would gladly accept his offer to show the lines, and that the lines desired to be seen were those of the higher bands, from "120,000" upward. No objection was made to this form of acceptance.

At an appointed time, one afternoon, the microscope was placed in a wooden cabinet which nearly excluded daylight, and light from a kerosene lamp with a large, flat wick, placed edgewise at a distance of about two feet, was admitted through an opening in the cabinet on a level with the nose-piece of the microscope. The stand was a large and heavy one made by Mr. Fasoldt himself, with about ten inches of tube-length including the objective, and furnished with a Bausch and Lomb $\frac{1}{12}$ in. hom. imm. objective claiming 1.40 n. a., and a 1 in. "periscopic" ocular by the same makers. The illuminating rays were brought to a focus at the side of the nose-piece, and about one-fourth of an inch from it, by means of a "watchmaker's glass" of about two-inch focus mounted as a bull's-eye condenser, the best effect being gained with an achromatic one said to have been made for the purpose. The divergent pencil was then admitted to the tube, and reflected downward through the objective by means of a cover-glass internal illuminator, claimed and patented by Mr. Fasoldt as his own. The peculiarity of this illuminator, aside from the oddity of its large size and square shape, the substitution of

Fasoldt's spring nose-piece for the ordinary society-screw to carry the objective, and an adjustment for withdrawing at will the cover-glass reflector from the optical axis, consists of an ingenious arrangement of shutters at the side, by means of which light is admitted only through a long, narrow slit that is adjustable in both width and position. With this arrangement a variety of bright or dark field effects were obtained by slight changes in the position of the lamp and the adjustment of the slit. When the image of the illuminating flame was formed by the objective just at the edge of the field of view and slightly out of the plane of the object, a transparent effect was produced over a considerable portion of the field, presumably by internal reflection at the bottom of the dry-mounted cover-glass, on the lower surface of which the lines were ruled, and in the bright portion of the field the lines of the lower-middle bands were very easily and distinctly seen.

Starting from any of the coarser bands, where there could be no question about the lines, the plate was moved across the field by means of the steady mechanical stage, and the lines of successive bands appeared with distinctness but increasing fineness up to the band claiming 110,000 to the inch, which was seen with perfect ease, and the alleged 120,000, which was seen clearly and repeatedly, though with difficulty, while in higher bands no trace or suspicion of lines was perceived. The same limit was reached in several separate trials by the writer, whose eyes, however, by reason of long over-use, should set no limit against the reasonable claims of others presuming to go further. Mr. Fasoldt himself did not seem to recognize the lines nearly as far up in the series as this; but his son, Ernest C., who was depended upon for most of the manipulation, was positive that he saw the lines in the "130,000" band, and none beyond that. Any importance attached to his judgment at this interesting point must be viewed in connection with the fact that on another occasion he was satisfied that he resolved a "200,000" band. No attempt to measure the spacing of the lines was made at that time, and none is ready to report now.

Mr. Fasoldt's faith in the integrity and visibility of the still higher bands, which faith, it is scarcely necessary to say, is not known to be shared by any scientific man, seems to depend wholly on his belief in the infallibility of his carefully concealed method of ruling them, and upon his impression that he has seen the lines as high as "150,000," and upon the equally firm impression of a few other persons that they have seen all up to and including the

"200,000." These persons, however, admit, that the higher bands furnish only passing glimpses, and cannot be kept in focus and examined at leisure or shown to other observers, as can be done with more or less ease up to "120,000." Is it possible, that, after looking long and intently at the coarser and really visible lines, the retinal impressions may remain and be recognized by the observer, while subsequently gazing at the higher bands?

On another occasion, when it was claimed that all the bands of a duplicate plate were resolved, and that the illumination was exceptionally good and the resolution exceptionally easy, the writer and his two friends with younger eyes who accompanied him, recognized the lines of the "110,000" band very easily and distinctly, but failed to go further.

It would be evidently improper to undertake to anticipate the action of the committee as a whole, by saying exactly what should be sufficient evidence, to establish the reality of certain of the lines and the fact of their resolution; but it will be noticed that the projecting alternate lines must greatly aid in the task of counting a measured portion of a band, either with a micrometer or by aid of photography. It can scarcely be long impossible to make a satisfactory count of the band claiming to be spaced at "120,000," if it is correctly ruled, since the lines really to be counted are only at "60,000." And if, which is not impossible, though not yet formally demonstrated, this band should prove to be successfully ruled and to be resolvable by existing lenses, a fact that has been plausibly claimed, but never yet really proved of any band of equal fineness, then the study of the next two bands would be one of the most interesting problems in the practical optics of the present day. At the same time it seems not improbable that photography may not only give us an easy count of lines visible, but extremely difficult to count otherwise, but may yet show the details of bands that are permanently beyond the reach of direct microscopic vision.

THE TAPE-WORM: METHODS OF PREPARATION.

COOPER CURTIS.

THE original investigations regarding the methods of preparation of the tape-worm for the museum and the microscope published in your issue for December, 1887, and presented before the Pittsburg assemblage of the American Society of Microscopists, 1887, have much of interest, and demonstrate the care and skill with which

the investigator, Mr. Stedman, has worked. The value of the work as independent, skillful investigation, is not in the least particular to be detracted from by the following :

While searching over past files of the Transactions of the Linnean Society, vol. II., 1794, I happened upon an article entitled "Observations upon the Structure and Oeconomy of those Intestinal Worms called Taeniae," by Mr. Anthony Carlisle, F. L. S., and read Nov. 6, 1792. Curiously enough, as will be seen by the extracts, the author presents the same methods and elucidates the same fact regarding the valves.

These two papers, written nearly a century apart, afford us much instruction as to the advance in technical detail lately arrived at. From the earlier paper we learn that "a powerful magnifying glass" revealed to him, the writer, no smaller elements than the so-called "globular bodies," which from inference I take to be those spots, which are called tests, and are so plainly seen with a loup. As might be expected, Mr. Carlisle failed in his deductions just where his microscope allowed him to speculate on the problematic functions of the different parts. Beyond mentioning the preservation of the Taeniae in "fine spirits," he gives no other methods than those contained in the quotations. The species experimented upon was Taenia Solum L., and, among other observations, he writes:

I have often injected three feet in length of these canals with coloured size, by a single push with a small syringe. The injection will not, however, pass from below upwards along these canals. I could never make it go in this direction beyond two joints, and it appeared to be stopped by valves in the lateral canals, situated immediately below the places where the cross canals are sent off. The alimentary canal, as it is here described, is continued into the extreme joint, where it becomes impervious, there being no opening analogous to an anus. The individual joints have each a vascular structure occupying the middle part which is composed of a canal passing from the top of the joint to the bottom, and from its sides are sent off a number of lateral canals nearly at right angles ; these vessels contain a fluid like milk, which is also globular, and after the death of the animal it is found coagulated. When injecting this middle vascular structure, I have often made the injection pass into the alimentary canals, by a number of very small openings, but could never, on the contrary, inject the central vessels from the alimentary canals ; it would seem as if there were a valvular apparatus fixed at the outer extremities of those radiated canals. The remaining part

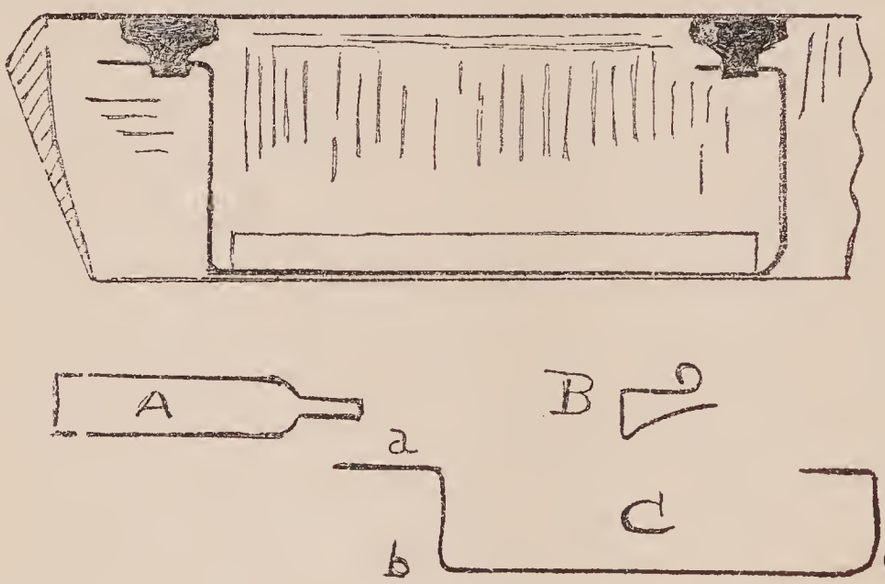
of the body is composed of a cellular substance. The mode of increase or propagation of these animals appears to be principally by ova. Linnaeus and many other naturalists speak confidently of the ova of Teniae, mentioning their shape, size, &c., but I have never seen anything like ova which I could decidedly say belonged to these animals, excepting some globular bodies which I saw by a powerful magnifying glass, in the ducts that opened into the lateral oscula There is every reason to believe that Taeniae produce ova, and that their ova, as well as those of other intestinal worms, are so constructed as to be very little perishable.

BUREAU OF ANIMAL INDUSTRY, WASHINGTON, D. C.

A NEW PLANISHER.

R. N. REYNOLDS, M. D.

IN using the section flattener in cutting thin sections by the paraffin method, we frequently need to wipe the edge of the knife, and for this purpose must slide the flattener off of the knife. To save this trouble I have devised the following form of flattener, which answers much better than the old one :



A New Planisher.

Take two strips of thin spring brass, each about one-half inch wide and one and a-half inches long ; cut them into shape A. The back of the knife is next laid across the centre of the wide portion, and the brass is bent up around the back of the blade, then curl the narrow portion around a knitting needle, completing the clip, the edge view B. Treat the other brass in the same way, fitting one snugly to the shank end, the other to the opposite end of the blade.

Heat about two inches of each end of the knitting needle, and

bend it into form C, being careful not to bend the portion b to d, which should be kept straight, to fit the edge of the knife. Take a strip of writing paper a little shorter than the straight portion of the wire, and about three-quarters of an inch wide ; gum and bend this around the wire. Bring the two edges together to form a curtain of the two thicknesses of paper. This curtain should stand at an angle of about 40° from the knife.

The curled ends of the brass clips can be turned up or down so as to bring the centre of the wire b to d just over the edge of the knife, and it should fit closely, but lie loosely on the edge. When we wish we can swing the wire and curtain back to admit of wiping, or with one motion to the right, remove it. When we wish to sharpen the knife, the clips can be slipped over the end of the blade.

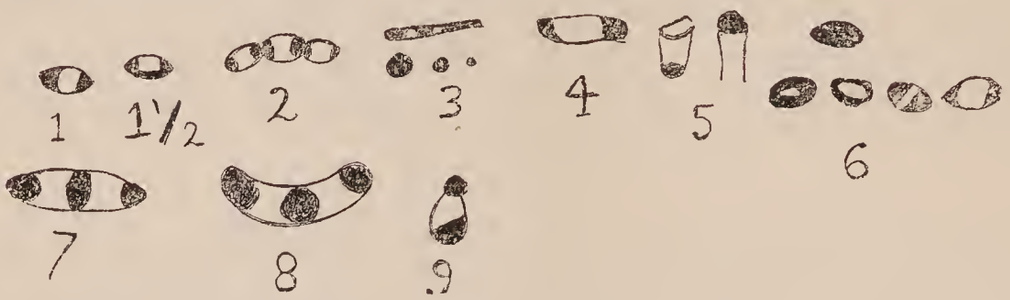
MORPHO-BIOLOGICAL CHARACTERISTICS OF THE GERMS OF THE SOUTHERN CATTLE PLAGUE AND THE AMERICAN SWINE PLAGUE, AND THEIR POINTS OF DIFFERENTIATION.

FRANK K. BILLINGS.

THESE two micro-organisms are neither to be classed with Micrococci or bacilli. They are not round objects like the former, or rods like the latter. They belong to the intermediate group, to which the name "bacteria" has been given. Their longitudinal dimensions are about twice that of their transverse. They are ovoid. Their ends are rounded. If an endeavor be made to differentiate these germs from one another by a microscopical examination we shall find it impossible. They are approximately of the same size and shape. Fresh specimens of them both will not differ so much in dimensions as old cultures of either will from fresh ones, or different individuals in the same old cultures. They are about one-sixth the transverse diameter of a red blood-cell in length. In one way, however, they can be easily differentiated even by microscopical examination. *The swine-plague germ has a far sharper affinity (its poles) for the blue and violet tinctions than that of the southern cattle plague, while the latter possesses a special affinity for fuchsin, which the former does not.*

Whatever the tinction used, if applied lege artis, the ends, poles, of these micro-organisms show a great specific affinity for the coloring material, *while the middle portion of their bodies has far*

less, unless the exposure is pushed to a longer period, when this portion of the body will eventually color. The capsule of these germs seems to be composed of the same material as the ends, as it also colors in the same manner, thus presenting a delicate line of colored material, connecting the two colored, coccoid ends, or poles. The most practical illustration which can be given of the microscopic appearance of these organisms is to take a small white bean and paint both of its ends and two of its sides, blue or red, leaving the middle portion unpainted. Looking down upon such a bean would give almost an exact picture of these germs.



Like the genuine and only germ of the American swine-plague (Mr. Salmon has split this disease into two and forged for one, which he now calls "hog-cholera," a description of a germ which does not exist, while for the other he has been forced to adopt the germ discovered by Detmers and myself), the micro-organism of the southern cattle plague *is motile in fluid cultivating media when studied microscopically, as well as in the serum from the blood of diseased animals.* The movements of the latter are, however, *less rapid or active* than those of the former organism.

In my earlier description of the micro-organism of the American swine plague, I called attention to the great morphological variations which it undergoes in its full cycle of development. These are its morpho-vegetative phenomena.

To one entirely unaccustomed to observing them, the first appearance of a cultivation of these germs—more especially an old one, would prove very puzzling. In fact the novice would very often conclude that his cultures had become polluted by micrococci, so plentifully are those objects, apparently, represented. They simply represent a vegetative, embryonic period in the development of this class of micro-organisms. Hueppe has fallen into the serious error of endeavoring to classify these organisms by this vegetative, morpho-condition. He calls them "Micrococci." To my mind it would be equally sensible and logical to call an ovum a man, or an apple seed an apple tree. It is far more practical for patho-biologists to stick to the name cocci for all round objects (not spores)

which have equal diameters in their mature form and which color diffusely, and to call these ovoid organisms bacteria, where the longitudinal diameter does not more than over again exceed the transverse. As to bacilli, spirrilli, etc., there need be no dispute so plain are their morpho-characteristics.

The mature micro-etiological organisms of the American swine plague and southern cattle plague has been described above (fig. 1) as resembling a white bean with the ends painted, as well as its sides, leaving the middle portion of its body unpainted, as we look down upon it. Now, that is the picture which the eye generally receives, but a more exact inspection of a stained covering-glass specimen will show that the above is not always the appearance presented to the eye, even by the mature germ. The above description depends upon the germ presenting itself to the eye in an exact horizontal position: that is, lying straight on its horizontal axis. If, however, it be turned a little one way or the other on its horizontal axis, numerous specimens will be seen where the white belt does not extend entirely across the object, as above described, but seems to be limited more or less to one side, and more of the colored substance will be seen on the opposite side than under general circumstances, or perhaps better in exact inspection (fig. $1\frac{1}{2}$). At first I mistook the appearance for the accumulation of the uncolored substance in this way during the process of its secretion from the colored ends, which I take to be the method by which this non-coloring material is produced. I believe that one of the best ways to instruct others is to chronicle our errors and explain them. Hence, I have done so in the preparation of this manuscript. More mature reflection has shown me that the above explanation is partially or wholly incorrect. It has been mentioned that that portion of the capsule of these micro-organisms must have the same chemical composition as the pole ends, because it also colors somewhat under the same application of the tinction. Now, why does it not show the same intensity of coloring? The only answer is: *that this capsule, being very thin, cannot take up as much color as the more dense pole ends; and being so thin, by the same amount of exposure, does not show any color when the middle of the object is looked directly down upon, but when the eye strikes the sides of the object, then we look through more material, and hence see more color.* Just as when we look at a piece of window glass, or a good glass slide, if we look directly through it it is colorless, but if we turn it on edge and look at it, it has a more or less green shade, according to the quality of

the glass. So, according to the amount of exposure to the tinction, when not carried so far as to color the whole body of the germ, we have more or less visible coloring of the capsule, which can only be seen when we look through a considerable extent of substance, that is, on the sides of the object.

Again we may see two or three objects united together, all presenting the normal characteristics of full maturity. I have never seen more than three of these germs connected together (fig. 2).

PROCEEDINGS OF SOCIETIES.

POSTAL MICROSCOPIAL CLUB.

OWING to a frivolous "legal objection," by the postal authorities, to the very modest form of sending the mailing boxes in their different circuits, much delay has been occasioned and many have been disappointed at the non-appearance of the ever-welcome and always interesting slides.

We have just received two boxes containing slides of peculiar interest. Box 37 contains a series that proves very interesting. The six slides were contributed by Mr. Jno. Kruttschnitt, of New Orleans, and represents the tea plant as grown in Louisiana. Slide No. 1 consists of transverse and longitudinal sections of flower stem. Slide No. 2, sections and cuticle of leaf. Slide No. 3, section of the ovary. No. 4, the epicarp. Slide No. 5 shows the seed capsule very clearly. Slide No. 6 shows sections of the cotyledon and epicarp.

This interesting series of specimens have been treated as follows: Cleared in a solution of caustic soda, bleached in chlorinated soda and stained with violet and aniline, then mounted in chloroformed camphor-water.

ST. LOUIS CLUB OF MICROSCOPISTS.

AT the meeting held in February, it was decided to give the students of the St. Louis College of Pharmacy a soiree, Tuesday evening, March 13th.

Frank Davis reported his investigation of ground spices from grocery stores. Some of the black pepper was adulterated with coal dust. Allspice was shown that contained a large proportion of "shipstuff." Mr. Davis will continue the investigation for a future meeting.

The members reported the results of their search for trichinæ. E. J. Nitschmann had examined sixteen rats and twenty-three specimens of pork, but failed to find trichinæ. J. C. Falk was more fortunate and found one rat with a diaphragm full of trichinæ. Other members reported on rats, rabbits, squirrels and hogs, but found no trichinæ. One medical student had examined specimens from thirteen cadavers without finding trichinæ.

Prof. H. M. Whelpley made a few remarks about trichinæ, and the methods of examining pork for them.

BUFFALO MICROSCOPICAL CLUB.

AT the meeting held Jan. 10th, the small attendance, due to the storm, was not an index to the interest exhibited ; the meeting merely became more conversational in its tone.

Mr. Henry Mills presented the club with a copy of Pott's "Fresh Water Sponges," for which a vote of thanks was unanimously extended.

The committee on reply to Prof. Minot's article in "Science" asked further time, as they were making investigations with lenses. It was stated that the "short German model," to which Dr. Minot pinned his faith, was being discarded in almost all the later makes of stand. Dr. Smith said they had compared a $\frac{1}{6}$ of Zeiss with a $\frac{1}{6}$ of Spencer and of Gundlach and a $\frac{1}{5}$ of Bausch & Lomb. That when the Zeiss lens was used with the Zeiss latest eyepieces the results were somewhat the better ; the Zeiss eyepieces were superior to any ever seen by the committee. It was due to American lenses to say that the ones of home make, used in the comparison, were not of the latest pattern, but were taken as being of the same focal length as the Zeiss, which was of the latest and finest that money could purchase.

Dr. Kellicott read Mr. Mills' paper, "Notes on Sponges."

Mr. Mills said he had searched Dakota for sponges last summer, and that his search was akin to looking for snakes in Ireland. Yet the season's work was far from naught. He had found, in August, a good specimen of *Myenia Crateriformis* which had two peculiarities specially significant. 1st. In the cratu terminating even with the surface of the globular statoblast. 2nd. The birotulates of the statoblasts lean toward and across each other. In November he received from Mr. Twitchell a specimen found in the Ohio River, which has proven entirely new. It resembles the *Myenia plumosa*, but differs in having two distinct kinds of birotulate spicula in the walls of the

statoblast, bringing it into the genus Heteromyenia, Potts, Mr. Mills names it *Heteromyenia radiospiculata*, N. Sp.

Dr. Kellicott read a paper on "The Coloration of Native Waters and the Causes." The most obvious analysis is as follows: 1. Inorganic matters in suspension. 2. Inorganic matters in solution. 3. Organic matters in suspension, and 4. In solution. Instances of the first class are the Yellow River and Sea in China, due to particles of loess. The azure of Lake Leman, due to rock material flowing from beneath glaciers. Of the second class, few and rare instances of colored mineral waters. Of the third class, these waters are suspicious, and the color is due to peat or hemlock, very little organic life in these waters on account of deficient aeration. Fourth class, color sometimes due to an algæ, as in the Red Sea. In the Schliersee, in Bavaria, color was first a bluish green, which turned yellow; the green was due to a Palmella, which was finally attacked and destroyed by the peach-colored micrococcus *Clatterocystis roseo persicuia.*

The fishy odor of the Boston water supply, some years ago, was due in part to a minute algæ, the *Coelos pleaerinum kutzingianum*, which turns water a blue-green. Finally the doctor said he had examined a water in the neighborhood of a decided green. In this he found very few infusoria or desmids or algæ of any kind. The stain seemed to be due to a minute form presumably a bacterium. "And," continued the Doctor, "when no other form can be found to stand for the cause of phenomena or troubles, is it not the fashion to assign the bacteria?"

The Doctor thought he had indicated enough to show where work might be done in the future.

LOUIS A. BULL, *Secy.*

ELEMENTARY DEPARTMENT.

RUDIMENTS OF PRACTICAL EMBRYOLOGY.*

SECTION II.

W. P. MANTON.

MATERIAL.

§ 4. Whether the hen or an incubator be employed, the eggs used must be newly-laid, in order that the stages of development may be accurately studied. Before beginning incubation the date and the hour at which this is to commence must be written on the shell with ink—and, as the eggs are placed in the incubator, should lie

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uppermost, so that they may be readily seen without disturbing the eggs.

The first eggs should be removed after about eighteen hours of incubation—when the first two layers of the blastoderm are well defined. After thirty-six hours the three layers, *epi*, *meso*, and *hypoblast* may be seen.

The eggs of forty-eight hours, three, four and five days, should be preserved. Older embryos, up to the seventh or eighth day, should be obtained for the study of individual organs. As soon as one egg is removed from the nest or incubator, another may be put in its place, and thus in the course of a week or ten days a sufficient number of embryos may be obtained to furnish work for the odd hours of many months. During incubation the drawers should be frequently opened and the covering cotton removed, in order that the eggs may get plenty of air.

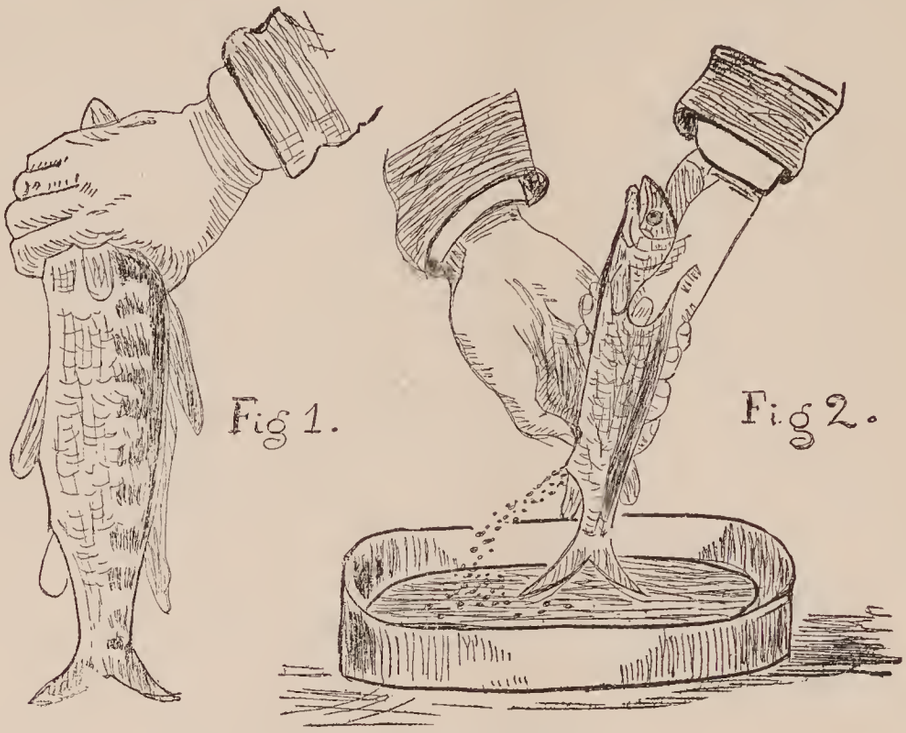
§ 5. The embryos of reptiles, amphibians, mammals and fish may be obtained as follows:

Turtles deposit their eggs in holes which they dig in the sand along the margin of streams and ponds. The time for laying is about sun-down; the period of the year, from the second week in June, varying with the locality. The eggs are hatched some time in September or October. As soon as a turtle is seen to deposit its eggs these should be carefully removed and planted in a box of earth, covered by wire-gauze or mosquito-netting. They must be kept moist. Incubation is very slow, so that an interval of several days should elapse between the examinations of the embryos. Turtles lay a large number of eggs, so that if a nest is found material will be plenty.

The eggs of frogs and toads may be found about the first of June in streams and ponds. The former occur in glairy, gelatinous masses; the latter in glairy, transparent strings. They should be placed in shallow dishes of water, and portions removed and hardened from day to day as the embryos develop. These latter appear as black spots in the centre of the transparent globules. The eggs hatch into tadpoles in about six or eight days.

Fish eggs: These and the embryos can best be obtained at a hatchery, but when this is inaccessible a spawning, adult fish may be utilized. "When a female fish is in fit spawning condition," says Francis, "the vent becomes slightly enlarged and of a reddish tinge. The ova, previously attached together by a membrane, become disconnected. Take up the fish and hold it, first, head

downward, then reverse it, and if the great bulk of spawn be seen to shift and drop as from one end of the fish's belly to the other, the eggs are loose and the fish is ready to part with its ova" (Fig. 1).



(From Francis.)

The method usually advised for holding the fish and expressing the ova is shown in Fig. 2. A still better method introduced by Mr. Glover is to hold the head of the fish with the left hand, seizing the tail in the right hand just behind the vent, so as to compress the back between the fingers and palm of the hand. The fish is then slightly bent, and the side of the thumb rubbed against its belly, just above the vent, which will cause the extrusion of the eggs. This should be done with the fish partially submerged in water. The sperm of the male is then obtained in the same manner, and in the same dish; and the eggs and the sperm gently mixed together by means of a feather. The eggs should now remain for about two hours undisturbed, and then transferred to the hatching trough or grille by a horn spoon and a feather. This hatching box, according to Exner, must have the floor covered with pebbles, while 1.5 c. m. above this is arranged a layer of glass rods, some 2 to 4 m. m. from each other. Upon these rods the eggs are laid. The box must then be provided with running water, the flow being drop by drop or swifter. Dead eggs may be recognized by their opacity, and should be removed each day. The eggs should be examined every twelve hours.

Mammalian embryos may be obtained, in the case of sheep, &c., at slaughter houses ; for those of small animals, as rabbits, mice, &c., the female must be killed at a varying period after fecundation

has taken place. The abdomen is laid open, the uterus and oviducts dissected and spread out, and careful search made with a lens for the eggs, which are removed and hardened.

A COURSE IN ANIMAL HISTOLOGY.

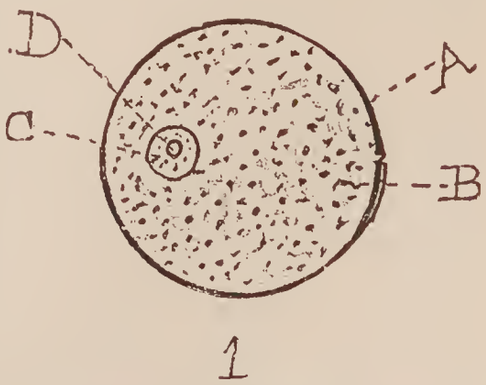
FRANK W. BROWN, M. D.

SECOND PAPER.

CELLS AND INTERCELLULAR SUBSTANCES.—As histology deals with cells and intercellular substances, their forms, structure and arrangements in the various organs and tissues, a few general points concerning their forms and structure will be helpful as an introduction to the more complicated study of their arrangement.

CELLS.—To one particular as to the use of words the name "cell" as applied to the anatomical units of an organ is an unfortunate one. The name was given at a time when our knowledge was imperfect, and is still retained, though attempts have been made to replace it with something more correct. *Cella*, a closet or storeroom, implies an inclosed space, and a cell was defined as a little body inclosed by a membrane and composed of a soft or fluid substance. This idea was formed from a histological study of plants, and the name "cell" can still be considered as correctly applied to the units of most vegetable tissues. In the animal kingdom, however, the case is different. None of the anatomical units are cells, as they possess no space-inclosing membrane, but are solid masses of matter. The name "cell" will, however, be employed in these papers, as, being the term in general use, it will create no confusion.

A typical cell (Fig. 1.), as described by the old masters, is a spherical or spheroidal body composed of a *cell-wall* (A) inclosing a soft, granular substance, the *cell-body* (B), imbedded in which is a much smaller, more delicate cell, the *nucleus* (C). This nucleus may in turn contain another delicate cell, the *nucleolus* (D), and this latter may rarely contain still another, the *nucleoleolus*. The cell-wall is generally homogeneous, that is, without any apparent structure, or it may have a delicate striated or fibrillated appearance. The cell-body is composed of small granules imbedded in a semi-fluid, colorless, homogeneous sub-



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stance. The nucleus, inclosed by its delicate, always structureless, membrane, is of the same structure as the cell-body, though possessing finer granules. The nucleolus and nucleoleolus are quite like the nucleus, though more delicate. So much for the results of Schwann's great work in the first half of the present century.

Modern investigation has changed many of these older ideas, though the features of the old cell are still recognized in the new. At the present time the conception of a typical animal cell is about like this: A cell-wall does not exist. This is without exception, although in reaching this decision over-fine distinctions may have been indulged. For all practical purposes the ovum with its *zona pellucida*, and a few epithelial cells may be said to possess a limiting membrane, but with these excepted there is little controversy regarding its absence. The cell-body is composed of a net-work of delicate fibrils, in the interstices of which is found a homogeneous, fluid substance. In some cells this fluid holds pigment granules, fat, etc. The nucleus is composed of a like, though more finely woven net-work than that of the cell-body. The net-work may thicken at the periphery and thus form a membrane for the nucleus; or a thin membrane, independent of the intranuclear net-work, may be present. The nucleolus is merely a thickening of the nuclear mesh. This net-work may be continuous throughout the cell, that is, the net-work of the cell-body may pass directly into that of the nucleus. A few investigators have gone even further and claim that this net-work is continued directly from cell to cell across the intercellular substances. To demonstrate this net-work requires the aid of the best immersion lenses and sometimes, unfortunately, the employment of special reagents. Notwithstanding, however, the careful directions given by the gentlemen who have seen and studied this inter- and intracellular mesh, it still remains for many of the best and closest observers to see anything of it at all.

ESSENTIAL PARTS OF A CELL.—The earlier histologists believed that every cell must possess the different parts of a typical cell, though generally in a less perfect degree. That is, any cell would be found to have a membrane, cell-body and nucleus. At the present time nothing but a cell-body is essential. A membrane seldom or never exists, and though the majority of cells contain a nucleus—a few having two or even three nuclei—a large number contain no nucleus, though it is presumed that at some time they must have had one.

FORMS AND SIZES OF CELLS.—The form of a typical cell is spherical or spheroidal. This form, however, can be attained only

when the cell is unhampered by outside influences. This condition of growth is practically impossible. The most potent modifier of cell-form is pressure, and the result of pressure is that there are nearly as many different cell-forms as there are cells. They may appear as flat, thin scales (Fig. 2.), squamous cells; or long and

thick, cylindrical or columnar cells (Fig. 4.), or short and thick, columnar or cuboidal cells (Fig. 3.) They may be spindle-shaped, stellate or star-shaped, or solid with many flattened sides—polyhedral cells. The sizes vary quite as widely as the forms, ranging between $\frac{1}{10000}$ to $\frac{1}{200}$ of an inch in diameter.

PROTOPLASM.—The matter of which all cells are composed has been variously named protoplasm, bioplasm, sarcode, etc. The first of these terms is the one now generally employed. Protoplasm is a nitrogenous, albuminous substance which is remarkable in that it possesses the unique and wonderful quality called life. Wherever life is found, either vegetable or animal, it is manifested through protoplasm, and it has, for this reason, been called "the physical basis of life." Attempts have been made to localize this matter in the cell. It has been held that the nucleus is alone composed of it, and again that it is the cell-body and not the nucleus. It seems more reasonable to assume that the cell-contents are all protoplasmic, though in a somewhat different state in the nucleus than in the cell-body.

INTERCELLULAR SUBSTANCES.—Though all tissues originate from cells it is seldom that a mature tissue will be formed entirely of cells, but that the cellular elements will be separated by intercellular substance. This substance may be structureless, fibrillated or reticulated. As a structureless substance it is found widely distributed and serves as a cement joining the cells together. All of the connective tissues have a fibrillated intercellular substance which may sometimes be so abundant as to make up the larger portion of a tissue. It must not be forgotten that this substance is derived from cells and that it has no power of reproducing itself. Just

what the method of its formation is is not known, though it is probably formed from the matter of the periphery of the cell, which is cast off as the cell grows.

EDITORIAL.

ORIGINAL RESEARCH IN AMERICA.

THE present age in medicine is preeminently one of experimental research. Thousands of busy hands are working in the laboratories, and to guide and interpret their work thousands of trained eyes are peering through lenses. It is impossible at this early date to fully estimate the results which have accrued to practical medicine and surgery, but they may be partially told in the wondrous tale of alleviation of suffering and preservation of life that have followed the introduction of antiseptic surgery. Our present methods may be proven faulty, and what we think now to be established facts, may be shown by more accurate experiment to be untrue. We may rest assured that the grand principles upon which we are working are correct. The experimental method, the founding of our medical structure upon demonstrated and repeatedly verified facts, is a step far in advance of the speculative methods of the past.

In this experimental research, which is becoming the foundation of modern medicine, Germany has the acknowledged lead. Of the other principal countries of Europe, France and Italy hold high places. England has been far behind, and her work in this direction has been insignificant. Her intense opposition to everything German has tended to prevent the introduction of German thought and methods. The English medical mind, moreover, following its great leaders in other departments of science, is given to ponderous philosophical thought—the building up of theories of etiology and systems of treatment—rather than to original experimental research. Until within a short time, America has been almost hopelessly in the rear, and it is not difficult to see the reasons for it.

Ten years ago a thorough education in practical pathology could not be obtained in the United States. Only the fortunate few who could spend a year or two in Europe, could have this knowledge. Of these few, necessarily accustomed to the luxuries of life, how many would be willing to turn aside from remunerative practical medicine to the precarious existence of the experimental pathologist?

Notwithstanding these obstacles, the few Americans who have devoted their energies to experimental pathology and bacteriology have shown themselves capable of work of the highest order. Witness the experiments of Prudden, Wood, Formad, Sternberg and others.

The conditions here, however, are now undergoing rapid change. The principal medical colleges of the country have established, by their own efforts or through the munificence of the friends of higher education, laboratories thoroughly equipped to teach the undergraduate practical pathology, and to carry on advanced experimental research. Each of the four large schools of New York and Brooklyn, Harvard, Yale, the Johns Hopkins University, now have ample laboratory facilities. The University of Michigan has imported an eminent teacher, Dr. Heneage Gibbes, and with the well-equipped laboratory it possesses, will enter the contest for supremacy with the Eastern institutions. Other provincial colleges must of necessity soon follow, and in a few years every medical graduate will have had an opportunity to study practical pathology under a competent teacher. Then the conditions of medical education here will approach more nearly those of the continent of Europe. With equal opportunities, American students will not long remain in the rear.

Then again, there is a change in the nature of the study of pathology. Before the development of bacteriology, microscopical study dwelt almost entirely with the results of disease, while now it searches for the cause. The eminently practical American mind can see the utility of such study in the problems of the prevention and cure of disease, and will enter into it with enthusiasm. We can confidently assert that experimental pathology has a brilliant future in America.

THE AMERICAN SOCIETY OF MICROSCOPISTS.

CHAMPAIGN, ILLS., March 8th, 1888.

THE eleventh annual meeting of this Society will be held at Columbus, Ohio, August 14–17, 1888. The invitation comes from the young and vigorous State Microscopical Society of Ohio, Dr. H. J. Detmers, President.

There has been, during some months, quite a contest between our friends in their different places, over the meeting for 1888, and the final vote of the executive committee has just designated Columbus as

the favored place. We are assured of great local interest and activity, and may expect the provision of every needful thing to facilitate our work, as well as a hearty welcome and pleasant entertainment.

It now remains for the members to properly accept the cordial invitation by a large attendance and a good program. The location is convenient and accessible, within easy reach of Cleveland, where the American Association for the Advancement of Science meets the succeeding week.

The names of the members of the committee on the "Working Session" will be announced later.

So far as can be seen all things work together for good in matters affecting the welfare of the society, except the unlooked for delay in publishing the proceedings for 1887. This is intensely annoying to all, but especially so to the publishing committee. All that can now be said is that considerable time must still elapse before the volume is issued.

T. J. BURRILL, *Secy.*

[We heartily indorse all that Prof. Burrill has said, and believe Columbus to be a most desirable place of meeting. We are sure that Dr. Detmers and the local committee will do all in their power to make the meeting a success, and it will be a success if the five hundred or more members of the A. S. M. will only turn out. Mr. W. James writes us that the hotel rates will be $2 per day, and the cost of travel one and a third of the regular fare. We shall have more to say in regard to this later.—ED.]

THE late J. C. Holmes, of Detroit, was an enthusiastic student with the microscope, and had accumulated quite an outfit in instruments, accessories and books, during his active life. Although of a quiet disposition, his zeal and interest in this subject will be long remembered by members of the Griffith Club of Microscopy, who now mourn the loss of a sympathetic worker and friend. Mr. Holmes was well known to most scientific bodies in this country from his long and prominent connection with the Detroit Scientific Association and other societies in this State.

MR. W. J. MORGAN suggests that an illustration and description of *A. neptunius*, described in a recent number of the MICROSCOPE, may be found in that delightful work of Gosse's *Evenings at the Microscope*. Mr. Morgan states that the book may be found in every town library;—but as it is inexpensive, we do not hesitate to recommend every beginner, at least, to possess a copy.

ACKNOWLEDGMENTS.—From Prof. Wm. A. Rogers, Waterville, Me., we have received several slides of his exquisite rulings, and eye-piece and stage micrometers; from Prof. Henry Mills, Buffalo, six interesting sponge mounts ; from W. H. Curtis, Haverhill, Mass., a slide of diatoms on algæ from Pacific coast. Dr. George W. Rafter, Rochester, has our apologies for tardy acknowledgment of three photographs Pleurosigma, illustrating his paper or the use of the Amplifier in Photo-micrography. These were taken with Bausch & Lomb's objectives $\frac{1}{5}$ inch and $\frac{1}{8}$ inch, student and first-class series respectively. The results are exceedingly beautiful.

TECHNOLOGY.

A CORRECTION.—The alcohol in Mayer's carmine, the formula for which was given in our March number, should be 85 per cent. instead of 8 per cent., as printed.

STAINING LIVING VEGETABLE TISSUES.—If a fresh, green stem is cut from a plant, and the newly-cut end be placed in a solution of any of the substances commonly used for staining, this coloring-matter will gradually be absorbed in the process of circulation, and be distributed through the tissues. Select a plant with the leaves sufficiently translucent to admit of examination by transmitted light under low powers. Cut off a small branch and place the end of the stem in a bottle or other vessel containing the coloring solution. Place the vessel conveniently near the microscope, so that one of the leaves of the cutting may be laid out over the stage, as is done with the foot of a frog in the examination of its circulation. Then watch the absorption of the coloring-matter as it passes from cell to cell.

In selecting specimens for use in this experiment the newest shoots will be found most satisfactory, because the absorption of the coloring-matter is more rapid, and, consequently, more easily watched. As the preparation is not a permanent one, it is unnecessary to give it the careful preliminary treatment required in mounting.

Some coloring-matters are more readily absorbed by the living plant than others. The various coal-tar derivatives are taken up very slowly, and so are the ordinary carmine and cochineal if simply dissolved in water. The most satisfactory, simply because they are the most rapid, are the colored writing-fluids of commerce, more especially the scarlet and purple. With some of these the leaf is thoroughly stained in the course of fifteen minutes, making a beautiful object even to the naked eye.

The study need not be confined to leaves, as the flowers may also be subjected to the same operation, and the mode of circulation be observed even in the organs of reproduction. In the leaves the stronger and more prominent veins do not take up the color readily while the plant is living, but the finer veins and cellular tissues are readily colored.

These coloring fluids may be injected into the stem of the rooted plant, but greater care and patience are necessary than by the methods of cuttings.—*American Monthly Microscopical Journal.*

SECTION FIXATIVES.—Of the three fixatives now in general use—shellac, collodion and albumen—shellac is considered the best for objects colored, *in toto.* The carbolic-acid shellac introduced by Mayer has been found to be unreliable in some respects. Carbolic acid warm is injurious to some tissues, *e. g.*, the dermis of vertebrates. The alcoholic solution is a perfectly harmless fixative. The method of using, which differs in important points from the one prescribed by Giesbrecht, is as follows :

A. The object slide, heated to about 50° C., is coated with shellac in the usual manner, by drawing a glass rod wet with the solution once or twice over its surface. As soon as the slide is cool and the film of shellac hard and no longer sticky, the sections are arranged dry, and then gently pressed down by means of an elastic spatula (horn or metal) until they lie flat and smooth on the slide.

B. Expose the slide thus prepared to the vapor of the ether. For this purpose the slide may be placed in a glass cylinder of suitable size and closely stoppered. The cylinder is placed in a horizontal position, or, at least, so inclined that the slide lies wholly above the ether. The saturation of the sections will be sufficiently complete in about half a minute.

C. The slide is next to be warmed in the water-bath in order to evaporate the ether. The paraffin is then removed and the mounting completed in the usual manner.

It is best to use balsam dissolved in turpentine or benzole, rather than in chloroform, as the latter softens the shellac, and thus often loosens the sections.

One advantage of this method of using shellac is that it permits of arranging and flattening the sections *on the slide.* Ordinarily, sections are placed while the adhesive coating is soft, and must then lie as they fall. With reference to collodion, Mayer remarks that it depends entirely upon the quality of the gun-cotton employed whether the section bear well treatment with alcohol and aqueous

fluids. When sections are to be stained on the slide the albumen-fixative is preferred to collodion. The mixture is prepared as follows:

White of egg, - - - - -	50 gms.
Glycerine - - - - - - -	50 "
Sodium Salicylate - - - - -	1 "

These ingredients are mixed and thoroughly shaken together, then filtered and kept in a well-cleaned bottle. Mayer has kept this mixture three years in a good condition. Other antiseptics have proved less efficient than salicylate of sodium.—*American Naturalist.*

ABSTRACTS.

FLOSCULARIA ANNULATA.

IN a recent number of *Science Gossip* Mr. John Hood describes this floscule, first discovered by him in 1882, in a marsh pool at Tents Muir, Fifeshire, Scotland. Length of adult $\frac{1}{64}$ to $\frac{1}{50}$ inch. The corona is a hemispherical cup, the edges of which are cut into three unequal lobes, that on the dorsal side being the largest. The tips of the lobes only are crowned with short setae (Fig. 1–2), which distinguish this floscule from *F. Trilobata* and *F. Hoodii.* A little below the corona are three rings (*r*), from which the floscule takes its name. At the bottom of the corona, just under the third ring, is the vestibule (*v*), where is visible a concollar, with a horse-shoe

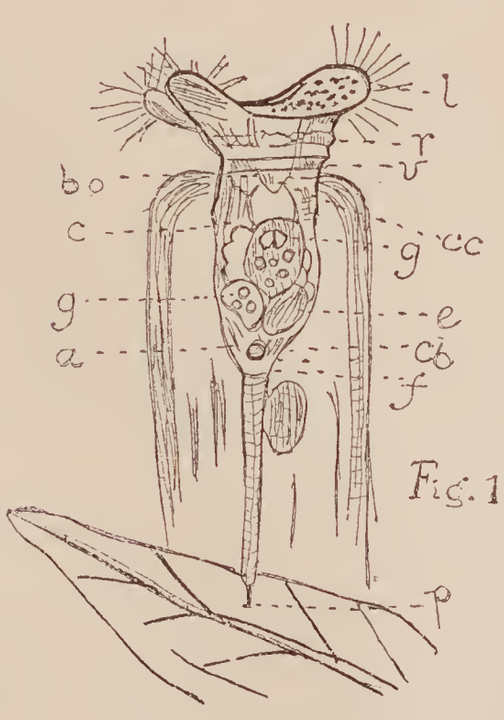

Fig. 1

Side View.

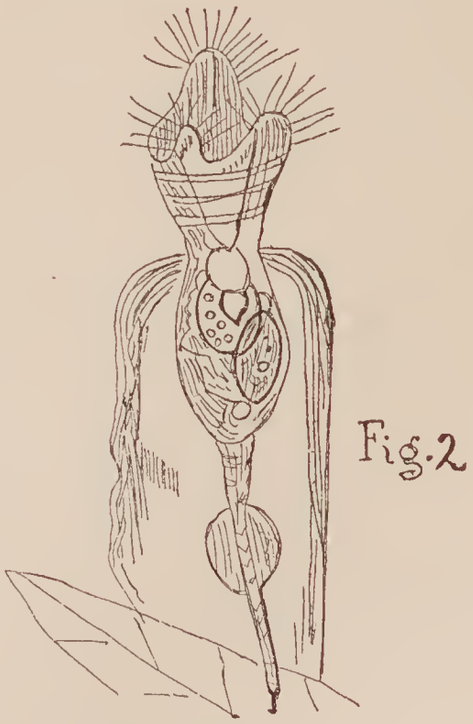

Fig. 2

Ventral View

shaped rim, clothed with vibratile cilia (*c c*), where motion generates an inward current, which carries with it infusorians within the expanded mouth funnel. At the bottom of the vestibule there is a slit with two lips, the buccal orifice (Fig 1. *bo*), to which is attached a tube that hangs into a chamber called the crop, (*c*), below which is the maxillary process. The ovary is an oblong sac with spherical, transparent germs (*g*), but when an egg is developed it is opaque, and fills a large portion of the body cavity (*e*), and when ready for expulsion the creature retires into its tube. The egg is at first forced half out of the vent, the animal then moves slowly out of its tube and comes to an erect position with its corona fully expanded. It remains in this position, if undisturbed, for nearly an hour, and then again retires into its tube to finish the operation of depositing the egg. With some apparent exceptions the creature lays the egg well down into its transparent gelatinous tube close to its foot. The foot itself (*f*) is long and flexible, and is capable of great expansion, and very swift contraction, for on the least alarm the creature retreats into its tube with lightning speed. A longitudinal muscle runs down the whole length of the foot and is strengthened by numerous fine muscular transverse rings from its junction with the trunk to its extremity, where there is attached a short, non contractile peduncle (Fig 1, *c*), which terminates in a disk which is fastened to a leaf sphagnum, or other aquatic plant, by a viscous fluid secreted by a gland at the extremity of the foot for the purpose. The respiratory or water-vascular system in F. annulata is not easily traced, as its trunk is rendered rather opaque by whitish granules that float in the fluid between the outer and inner membranes. But when the creature is kept for two days in clear water without proper food, it is so starved that it becomes very transparent, so that the details of the internal organs can be traced with less difficulty. The slender tortuous vessels can be observed leading down to the contracting bladder, situated near the junction of the foot with the trunk (Fig 1, *c. b.*). The F. annulata inhabits a transparent tube secreted by the animal itself, which serves to protect the creature from its natural enemies, and its eggs from the ravages of aquatic worms and larvæ, only a few of which can penetrate the tough tube.

This floscule deposits from three to six female eggs in its tube, and it requires five or six days for these to hatch. Six or eight hours before the embryo bursts from its shell, two red eye-spots are very conspicuous ; also a ciliary motion, and a twitching of the whole contents of the egg, are observed. The twitching becomes yet more

vigorous, until at last the embryo bursts through, and, propelled by a wreath of delicate frontal vibratile cilia, it soon finds its way out of its mother's domicile, and swims rapidly round its parent; then strikes out with a graceful motion through the water, poking among the weeds in quest of a fitting place to start house-keeping on its own account.

HUMAN OVUM.—Dr. W. Nagel communicates a description of the human ovum, in regard to which there has been a lack of precise information. His material was obtained from ovaries removed in operations. Healthy follicles were isolated and examined, and in other cases sectioned *in situ*.

The zona pellucida is very distinct, and is separated by an extremely fine "perivitelline space" (apparently containing clear fluid) from the vitellus. Within this is the narrow, clear "cortical layer" of vitellus, then a somewhat broader, finely granular "protoplasmic zone," then the "dentoplasmic portion," with abundant globules, more abundant and less refractive than in the ova of the domestic mammals.

The nucleus is round, clear, double-contoured, always eccentric, and in the protoplasmic zone. There is a distinct nuclear network. The nucleus exhibits amœboid movements.

The corona (epithelium of ovum) was always well developed on ripe eggs. The diameter of the ripe ova varied from 124–128 mm. The various zones vary somewhat in different regions. The nucleus measured 19–20 mm.

In the ovaries of new-born subjects, besides the usual primordial follicles, larger follicles were observed (Waldeyer-Slavjaushy). In these, sections revealed normal ova, and the author does not, therefore, regard the presence of these large follicles as indicative of incipient cyst-formation.

In development, the protoplasm and nucleus increase in size, the follicular cells multiply, the dentoplasm is formed, the nucleus is pushed to the side, and a zona pellucida begins to appear.—*Roy. Mic. Journal.*

NEWS AND NOTES.

THE proper committee in Congress has recommended the removal of duty on alcohol which is to be used in the arts and manufactures.

MR. DOUGLAS H. CAMPBELL, of Detroit, has an interesting sketch

in the *Botanical Gazette* for January, of the Botanical Institute at Tübingen, where he is now working.

PROF. L. VON CIENKOWSKI, the Russian bacteriologist, died in Germany last October.

PROF. ANTON DE BARY, the botanist, whose work on the fungi has made him eminent, died at Strassburg, Germany, in January, aged 57.

BOOK REVIEWS.

LOMB PRIZE ESSAYS.

We have received these four essays, pamphlet form, on: "Healthy Homes and Food for the Working Classes," by Victor C. Vaughan, M. D., Ph. D.; "The Sanitary Conditions and Necessities of School Houses and School Life," by D. F. Lincoln, M. D.; "Disinfection and Individual Prophylapis Against Infectious Diseases," by Geo. M. Sternberg, M. D.; and "The Preventable Cause of Disease, Injury and Death in American Manufactories and Workshops, and the best means and appliances for Preventing and Avoiding them," by Gerge H. Ireland. The first costs 10c., the others 5c. each. At this price, these important and valuable articles should be read by everyone. They may be obtained of the Secretary, Dr. Irving A. Watson, Concord, N. H.

THE TONGUE AND GUSTATORY ORGANS OF FIBER ZIBETHICUS. By Frederick Tuckerman, M. D. Reprint.

ON THE USE OF THE VAGINAL TAMPON IN THE TREATMENT OF CERTAIN EFFECTS FOLLOWING PELVIC INFLAMMATIONS. By T. A. Emmet, M. D. Reprint.

MODERN TREATMENT OF HEADACHES, by Allan McLane Hamilton, M. D. Geo. S. Davis, Detroit.

Number 6 of the *Physicians' Leisure Library* appears with the above title, contains 124 pages. The author discusses six varieties of headaches under the pathology, differential diagnosis and treatment, introducing many formulæ that have been tested and found good for the different diseases. A few plates are added and an excellent index completes the work.

LECTURES ON BACTERIA, by A. DeBary, Professor in the University of Strassburg. Second improved edition. Authorized translation, by Henry E. F. Garnsey, M. A., Fellow of Magdalen College, Oxford. Revised by Isaac Bayley Balfour, M. A., M. D., F. R. S., Fellow of Magdalen College and Sherardian, Professor of Botany in the University of Oxford. New York: MacMillan & Co., 1887.

This book is a short abridgement of a course of lectures delivered by the author before an audience composed of persons of very

different professional pursuits. It forms, then, an excellent introduction to the study of bacteria, for both medical and non-medical readers. The author has kept constantly in view the connection with the known facts in the life of bacteria with those with which we are acquainted in other branches of natural history.

A very satisfactory account is given of the structure of the bacterian cell and the course of development, species, origin and distribution of bacteria. The casual connection of parasitic bacteria with the infectious diseases has received abundant attention. It gives concisely the facts which every physician must know, and which should be known by every educated man. The chapter devoted to the mycotic diseases of insects and plants, contains some very potent arguments, sustaining by analogy the bacterial theory of infectious diseases. A copious conspectus of bacteriological literature ends the book.

It is one of the very best books upon this subject that we have seen.

CORRESPONDENCE AND QUERIES.

CHICAGO, Feb'y 15, 1888.

EDITOR OF THE MICROSCOPE :

Your editorial in the January number, as to widening the scope of Microscopical Societies, contains such wise suggestions, it will be well for the many nearly lifeless societies to give heed and adopt the plan proposed. There has been too much tendency to regard microscopy as an esoteric science, in which those outside are not expected or desired to take interest, except at soirees. The reason for this is in the obvious fact that the very large majority of persons absorb all their leisure in music, dancing, games, novels and frivolity. They are not, perhaps, culpable in this condition. Evolution has been belated with them, and it is in violence to their natures to expect them to become microscopists, even for diversion. Yet, in all communities, there are some, and in large cities, many, who are suited and inclined to scientific pursuits; but few of whom develop in that direction because the esoteric conditions repel them.

If inclined to microscopy, unless the individual is exceptionally fortunate in having some friend to aid him in learning the methods, he will find that he must struggle alone with the text books. So slow will be his progress, that if not very fervent in spirit he will

abandon the effort, as a novice to propose membership in a microscopical society would be mutually regarded as an impertinence. He might readily have a teacher for the banjo or the accordion, but not for the microscope, except in such advanced cities as Boston and Detroit.

To meet this condition of affairs, and afford opportunity for the growth of amateur microscopists in its vicinity, the Illinois State Microscopical Society has taken the initiative in the new method. It has partly opened its doors to beginners, and already made so much of a success in the experiment, as to demonstrate the great possibilities in that direction. For prudential reasons only limited publicity was given to the new departure, lest the society might, in so large a city, be overwhelmed with the inexperienced members who, if too numerous, might not receive the attention promised. In fact, the considerable increase in membership has come from almost confidential disclosure of the new plan of giving them of the science of microscopy without money or price, beyond the almost nominal dues. The experiment has made apparent that there are many who will come to this science if an inviting opportunity is afforded.

Doubtless some of these new members will "fall by the wayside" and not go very far when they learn that it is not so easy, or funny, as they expected. But there will be some of them to become experts, and if the plan is continued there will be enough obtained who will hold to the faith and help to make an interesting and valuable society, such as never could have resulted by continuing vain attempts to add to its growth at the wrong end. To maintain a practical interest at the meetings, the "working session" method of instruction has been adopted. Fortunately the Society has enough experts in special lines to furnish many sessions, at which the varied process of work will be shown. While thus the methods will be disclosed, it is not desired that the beginners will attempt them all; but will, rather, as his taste may suggest, select one line on which to concentrate with more prospect of marked success.

The experienced members acting under the plan as tutors will naturally give a diversified direction to the work of the beginners, who, as they progress, will react with benefit to the tutors in compelling them to sharpen their attention to the subjects under consideration.

Thus, while they may seem to be losing time with the beginners, they will be likely to make quite as much progress for themselves.

B. F. QUIMBY.

P. C. C., M. D., New York.—In order that your question in regard to the society screw might receive the most careful attention, we have asked Mr. Bausch, who was appointed on the committee of the A. S. M. to consider this matter, to give us whatever information he could. Below we print his letter in full.

EDITORS OF THE MICROSCOPE :

Your favor of the 20th inst. is at hand, and it gives me pleasure to impart as much information on the subject of society screw as possible.

When I read a paper on the subject in '84 I looked up all the literature on the subject which I could reach. I also had a copy of the report of the original committee which determined the standard screw, and quote below their words :

" A screw, containing 36 threads to the inch, having an angular thread of 54 degrees, slightly rounded off at the top and bottom, has been considered the most appropriate. The largest linear aperture, at the junction of the object-glass with the body of the microscope, will be required for objectives of low power having the widest compatible angle of aperture ; this is not likely to exceed .72 to .73 inch with the greatest diameter of field-glasses now in use ; hence .8 inch may be taken as sufficient for the external diameter of the screw. The length of screw recommended is $\frac{1}{8}$ or .125 inch comprising four and one-half threads, and that of the guide or collar .15 inch."

You will note the ambiguity of the instructions. Prof. Rogers and myself, as committee of the American Society, have endeavored to induce the Royal Microscopical Society to take the matter in hand and at least co-operate with us, but all the definite information which we have been able to receive has been to the effect that they consider a change impracticable on account of the expense involved to the maker.

We have not yet ceased to hope that something definite may be effected, but have not been able to do more on account of the want of time. You, as well as almost all microscopists, are aware of the discrepancies in the standard screws, and your journal would no doubt be doing a good service by favoring a proposition to do something to change this state of affairs. The American manufacturers have all expressed themselves in favor of adopting a standard on which dependence can be placed.

With kind regards, I am,

Very truly yours,

EDW. BAUSCH.

EXCHANGES.

This department is for the benefit of SUBSCRIBERS *who have microscopical apparatus, material or books which they wish to exchange, and such wants will be* INSERTED FREE OF CHARGE. *The number of insertions given will depend upon the number of exchanges received each month. Subscribers will please notify us when articles have been exchanged or sold. Dealers are referred to our advertising department.*

WANTED TO PURCHASE—Second-hand copies in good condition of Rev. Wm. Smith's "British Diatoms," and "New Greville Plates of Diatoms."
JAMES B. SHEARER, Bay City, Mich.

FOR SALE—A physician's microscope, manufactured by Bausch & Lomb; 2 eye-pieces; 2 objectives, 3-4 and 1-5; micrometer and camera lucida. For further particulars address A. W. ALLEN, 410 Grand River Ave., Detroit, Mich.

FOR EXCHANGE—Diatomaceous earth from the plateau of Thibet (12,000 feet) varieties localities; also material and slides from localities in Scottish Highlands. Wanted, slides of American Diatoms, Insects and Botany.
W. D. STEWART, 2 Gilmore Terrace, Edinburgh, Scotland.

FOR EXCHANGE—Injected cysts of Trichina Spiralis.
GILMAN DREW, Iowa City, Iowa.

WANTED—Parasites and books on Parasites and other micro-subjects; will give Anatomical, Pathological, Botanical, Microfungi, Zoophytes, Polycistina, Foraminifera, Parasites, and other slides in return. Shall be glad to open an exchange at any time with micro-correspondents for any of the above subjects.
FRED. LEE-CARTER, Gosforth, near Newcastle on Lyne, England.

FOR SALE—A Bausch & Lomb Model Microscope, with 1 in. and ¼ in. objectives.
W. H. OSBORNE, Chardon, O.

I HAVE a good "Little Monitor" local telegraph sounder and straight lever key (cost new, about $6 to $8), both in good order; also, a Wirt fountain pen (one of the best made, cost $2.50, good as new, having been used but very little; one copy, in cloth, of "Parson's Handbook of Business and Social Forms," 500 pages, $3.50; never used. I wish in exchange, latest editions of Beale's "How to use the Microscope," "The Microscopist," by J. H. Wythe: Rev. W. W. Spicer's translation of Johann Nave's "Handbook of Collection, Preparation, etc., of Algæ, Diatoms, etc.," or other microscopical works. Correspondence solicited. F. W. DUNNING, 32 So. Division St., Battle Creek, Mich.

WILL EXCHANGE—Cabinet specimens of gypsum, specular, micaceous, massive and earthy hematite, slides of diatoms, and literary and scientific works, for well mounted slides, tubes of cleaned diatoms, and standard books on microscopy.
A. F. BARNARD, Box 152, Oberlin, Ohio.

FOR SALE—Powell & Lealand No. 3 Microscope stand, with three eye-pieces and several accessories. Address, A. L. WOODWARD, 53 Lansing St., Utica, N. Y.

BONE and fruit-stone sections for good, medium-angle objectives, 1-5 to 1 inch.
A. E. WARREN, Rio Vista, Virginia.

WANTED TO PURCHASE—*American Journal of Microscopy*, Vol. I, 1876, No. 8, Vol. III, 1878, No. 2. *American Monthly Microscopical Journal*, Vol. VII, 1886, No. 11.
C. C. MELLOR, 77 Fifth Ave., Pittsburgh, Pa.

MR. EDITOR—Will you allow me to say, through the medium of your pages, to the numerous correspondents who have written me in reply to my notice in your Exchange Column, that I exhausted my stock of slides of salicine and urinary deposits within a few days after the appearance of the notice, and that my ever-increasing duties as editor and physician have thus far given me no opportunity to make any fresh ones. Whenever I can get a few hours of leisure I shall make enough to supply all those who have written me, and will give immediate notice thereof in THE MICROSCOPE.
FRANK L. JAMES, M.D., Box 568, St. Louis, Mo.

FIRST-CLASS HISTOLOGICAL AND PATHOLOGICAL MOUNTS in exchange for instruments or books on Microscopy.
A. J. C. SAUNIER, M. D., 92 Laflin St., Chicago, Ill.

WANTED—Nos. 1, 2, 3 and 5 of Vol. I of THE MICROSCOPE—25c each paid. Address this office.

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No receipt will be sent for subscriptions received unless specially requested.

Specimens for examination should be sent to the *Microscope Laboratory*, 25 Washington Avenue, Detroit, Mich. In all cases the transportation charges on these specimens must be prepaid, and special directions for packing and shipping will gladly be sent upon application.

VOL. VIII. DETROIT, MAY, 1888. No. 5

ORIGINAL COMMUNICATIONS.

THE OIL-BEARING SEEDS.

C. M. VORCE, F. R. M. S.

II.

FLAX SEED.

[PLATE V.]

NEXT in importance, commercially, to cotton seed comes flax seed or linseed, the seed of *Linum usitatissimum*, which was, indeed, until a late period the most important of the oil-bearing seeds. The flax plant antedates all history in antiquity of cultivation, and the earliest mention of it in the Bible, the writings of Pliny, etc., places it of equal importance with the cereal crops, its fibre being the object of its cultivation. "Fine linen" was a luxury long before the days of Christ, so much so, that in the Old Testament the raiment of the angels was referred to as composed of it, and it was a sacrilege for the high priests to wear garments in which wool was mixed with the linen. To this day *fine* linen has not ceased to be a luxury and a delicacy, but the fibre of the plant, having been largely supplanted by cotton, and owing to the increased use of linseed oil in arts and manufactures, is no longer the chief object of its cultivation. The flax plant has a wide range, flourishing everywhere between 60° of latitude, and it is a singular fact that the seed most esteemed for the manufacture of the oil is that imported from the Baltic ports of Russia and that from India. In America the seed

grown in Canada and in the northwestern territories is preferred as being richer in oil.

The flax seed is hard, smooth, flattened, of a reddish brown color, averaging, when plump, about 5 mm. long, by 2.5 mm. wide and 1.2 mm. thick, thinner and beaked at the hilum (Fig. 1), usually with a white or lighter colored edge. Owing to its shape and smoothness, the seed is slippery and unstable in mass, and when stored in bulk, exerts a greater lateral pressure than any other grain, and hence requires storehouses for holding it to be very strongly built and tied. Although seeming so hard and smooth, the seed is in fact not microscopically smooth, and is very pervious to moisture. Viewed as an opaque object, the seed is seen to be covered with very shallow concave pits, giving the surface exactly the appearance of the hammered sheet metal so much in use for ornamental purposes. (Fig.1, a.) This appearance is caused by the sinking in of the outer wall of the surface cells, the partition walls of which form the boundaries of the pits. An attempt to delineate this appearance, more highly magnified, is made in Fig. 2. On applying water to the seed, the outer cells are seen to quickly swell up, the partition walls rupture, and vesicles, many times larger than a dozen of the original cells, cover the surface; the water, on drying, leaves a gummy deposit, and the seed is left rougher and less glossy. (Fig. 3.)

Contrary to usual experience, the structure of the seed in this case cannot be so well made out from sections as by other means, the testa being so hard and brittle that suitable sections cannot be made, but by studying sections of the dry seed in various fluids, and by acting upon the seeds and sections with various re-agents, the structure may be ultimately made out. A thin section from the outer surface, examined in turpentine, appears as in Fig. 3. A transverse section of the seed, in the same fluid, shows the testa to be composed of two coats (Fig. 4), an outer thick, yellow layer, and an inner thin, bright red layer, closely adherent to the cotyledons, which are composed of regular, compressed, thin-walled cells, filled with oil drops (Fig. 4, a), and some minute granules of starch. But little of the structure of the outer coat can be made out in turpentine; it much resembles muscular fibres, but at thin edges of fractures, shows projecting cells pitted with minute perforations, as shown at a, Fig. 8. The inner coat, however, is seen to be composed of thin, flattened, solid, red blocks, some of which will be found lying separate (Fig. 5, a), mostly quadrangular and strongly resembling in appearance uric acid crystals. These are arranged in

quite regular rows, occupying the cells of a thin, hyaline, cellular membrane (Fig. 5, b), and irresistably remind one, by their color and arrangement, of a brick pavement. The membrane is seated directly upon the cells of the cotyledon, and the partition walls of its cells are thickened and beaded. (Fig. 5, c.) A higher magnification shows that the edges of the red blocks are finely serrate (Fig. 5, c), and the partition walls of their investing cells correspondingly notched to fit them. (Fig. 5, d.) It seems obvious that these red blocks are the solidified contents of the cells they occupy, and that they are in fact overlaid by an outer cell-wall, but I have been unable, even with a great number of specimens, to demonstrate its existence.

The seeds, when placed in water for a few hours, yield an abundant colorless mucilage, by which a moderate quantity of water is emulsified to a jelly. That this is mostly yielded by the testa, is seen by a section of the soaked seed after boiling it in a fresh quantity of water. The cotyledon is but slightly changed, but the coats of the testa are swollen and separated by a clear space, the outer cells ruptured (Fig. 6), the oil-drops occupy less of the now enlarged cotyledon-cells, and the latter, where the oil-drops have escaped, discharge a cloud of minute starch particles. (Fig. 6 a.) The elements of the husk or testa are, however, still indistinct in the swollen section, but the cotyledons of the boiled seeds are readily squeezed from the testa, leaving the same in a condition to be easily teased out and examined. Heating a few of the dry seeds in nitric acid causes them to lose their color and soften, and the outer coat of the husk comes away as a white film, leaving the inner coat and cotyledon pale yellowish, soft and easily crushed to pieces. By examining in water or glycerine the teased-out coatings of the testa and fragments of the cotyledon obtained by these methods, a satisfactory determination of the structural elements is arrived at. First, however, a section of the dry seed is treated with water, when the outer cells of the testa instantly swell up, their partition walls presenting a wrinkled appearance (Fig. 7, a), and the whole substance of the outer coat slowly thickens and swells, which action is hastened by the application of potash solution. By treating the section with successive quantities of potash, or of ether or chloroform, the oil globules diminish and finally disappear, presenting successively the appearances shown in Fig. 7, b, c, d, e.

The structure of the outer coat of the testa, as revealed by the teased-out specimens, is shown in Fig. 8, which represents, diagram-

matically, a very oblique section, the various elements of which have been drawn from a number of different preparations in their proper order. The inner surface is at the left, the upper half of the figure showing the appearance as each successive layer is focussed, and the lower half the structure of the particular layer in focus. The outer cells (g) are much swollen and thickened, and show the separation of the cell-wall layers. The next layer (f) is of smaller cells, and the following, or inner layer (d), of large cells, is composed of nearly quadrangular cells, arranged in longitudinal series, and at some points in the acid-boiled specimens, resembling mere rounded openings in a structureless membrane. (c.) These layers of cells are entirely empty, having contained mucilaginous matter only. Next comes in several layers of long, narrow, dotted cells (b), longitudinally arranged, of deep yellow color, with a few minute oil globules among them, and lastly, a single layer of thin, narrow, structureless cells, transversely arranged. (h.) At the edges of the seed are a few longitudinal bands of spiral vessels (Fig. 9), lying among the dotted cells (a) and nearest the inner surface. The inner coat of the testa is scarcely changed by boiling in water, but in nitric acid a remarkable change is effected in the red blocks, which are converted into globular concretions of radiating needles, closely resembling those of carbonate of lime (Fig. 10), while their cellular membrane, before colorless, is now a light yellow color. The cotyledon cells are swelled and softened, but not otherwise changed, and the starch has disappeared.

Collating the foregoing observations, we deduce the structure of the flax seed as follows: The cotyledons, composed of ordinary cells, filled with an abundance of oil and considerable starch, in minute granules, are enclosed in a hard, brittle testa, of two separable layers, the inner of which is composed of a single layer of solid, mostly quadrangular, thin, red blocks, of probably alkaloidal nature, with finely serrate edges, enclosed in a correspondingly serrate, cellular membrane, adherent by a mucilaginous or albuminous stratum to the surface of the cotyledons; and the outer layer of testa, separated from the inner by a mucilaginous stratum, is composed of a single transverse layer of thin, linear, hyaline cells, overlaid by several layers of yellow, longitudinally arranged, dotted cells, containing localized bands of spiral vessels and minute oil globules, and enclosed in three or more layers of large, thin cells, containing a very soluble mucilage and forming a shallow, pitted surface of the seed when dry.

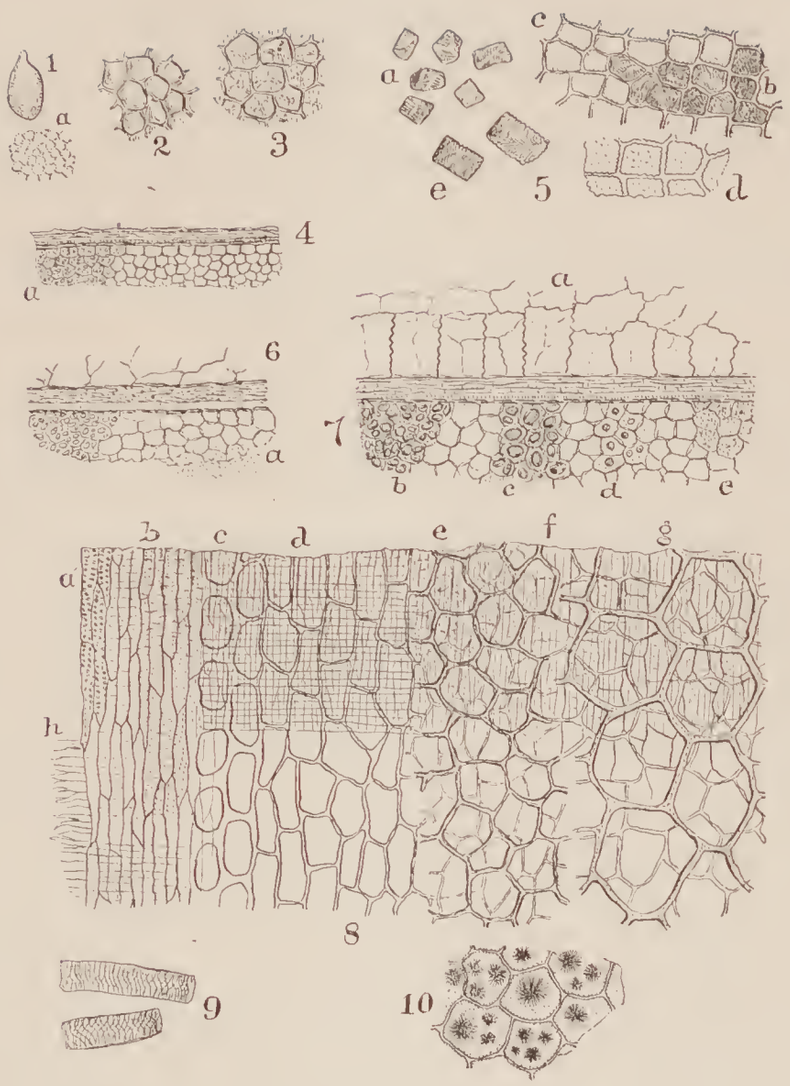


PLATE V.

DESCRIPTION OF PLATE.

Figure 1. Flax seed, × 2½. 1 a, surface × 90.
Figure 2. Surface of dry seed, × 245.
Figure 3. Surface of seed after soaking and drying, × 275.
Figure 4. Section testa and part of cotyledon, × 275.
Figure 5. Inner layer of testa, a, b, c, × 245; d, e, × 275.
Figure 6. Section of testa, etc., of soaked seed, × 245.
Figure 7. Section of dry seed in water, etc., × 245.
Figure 8. Structure outer coat of testa, diagrammatic, × 275.
Figure 9. Spiral tissue, × 245.
Figure 10. Inner coat of testa, boiled in nitric acid, × 245.

THE MOUNTING OF SERIAL SECTIONS.

CHARLES SEDGWICK MINOT.

EVERY one knows that the art of making and preserving long series of sections is one which has acquired the highest degree of importance for various biological and particularly embryological researches. It is, therefore, very important that the art should be brought to as high a degree of perfection as possible. My own work has rendered this very desirable for myself, and I have spent a good deal of time in testing the various methods that have been recommended. The result of these trials has been the selection now from one authority and now from another of various methods of treatment and manipulation, which as I now combine them in my practice, yield me on the whole the best results which I have obtained up to the present time. I have thought that it might interest others and perhaps save them some time to have the results of my experience, together with mention of the special precautions which I have found it advisable to take.

First of all, I would state that it is my conviction that more perfect and satisfactory series can be prepared with the aid of some form of automatic microtome than by any of the older forms of sledge or other microtomes with which we are familiar. It is extremely difficult for the hand to acquire the steadiness and precision of movement possible with a mechanical appliance; it is always likely that a fine piece of apparatus working automatically will prove a better instrument of precision than an apparatus worked by the hand. Personally, I have found the automatic microtome made by G. Baltzar of Leipsic, to be entirely satisfactory, and as it is not expensive it seems to me, that it may be highly recommended.*

* The microtome may now also be obtained from the Educational Supply Co., 6 Hamilton Place, Boston, Mass.

In cutting, it is of the greatest importance to have the blade of the knife perfectly clean ; I am in the habit therefore of washing my microtome knife in boiling water, every time after using it for cutting paraffine, and then to wipe it off carefully with alcohol ; if this is done conscientiously, there is little risk of the surface of the knife getting soiled by the paraffine, and therefore very little risk of any of the sections sticking to the blade of the knife and interfering with the smooth slipping along of the ribbon of sections. As regards the imbedding of the object, paraffine is the most useful material, of course. I find a mixture of seven parts of hard paraffine with twenty parts of soft paraffine the best. In warm weather a little hard paraffine may be added, and in very cold weather it may possibly be necessary to make a trifling addition of soft paraffine. The paraffine is kept in a bath at a temperature of 57° to 59° centigrade. I consider it extremely important that the paraffine should be filtered. For this purpose I use a hot water filter of the type so well known in the chemical laboratory. The filter itself is a double case of copper, which may be filled with water ; inside is a copper funnel; below the filter is placed a ring burner by which the water in the outer case is heated; a pipe runs from one side of the funnel and is connected with a large Mariotti's flask, so that when the funnel is heated and there is loss by evaporation the supply is kept up for a long time at a constant level. It may be remarked that it is desirable to use rubber stoppers for the Mariotti's flask, as it is very difficult to make corks fit air-tight. The inner funnel is furnished with a piece of filter paper, and the whole has a cover to keep the heat in ; as soon as the paraffine is melted it flows through the paper quite rapidly, and comes out perfectly clean. I have learned by experience that the lines, scratches and tears which one gets in sections during paraffine cutting are due usually to the presence of minute particles of dirt in the paraffine, and if the paraffine is filtered and carefully kept free from dirt the edge of the knife will last much longer, and the sections come out much more perfect. The filtering of paraffine may be considered an indispensable process for those who want to make perfect sections.

The process of imbedding which I ordinarily employ, my work being principally with vertebrate embryos, is as follows: the tissue is kept in 70° alcohol until the process of imbedding begins. For imbedding, the tissue is first dehydrated in 96° alcohol, and then soaked in a mixture consisting of equal parts of oil of cloves and spirits of turpentine for a few hours, varying according to the size of the piece, or sometimes left over night ; it is then transferred to

the bath and placed in soft paraffine, in which it is kept at a temperature of 57° to 59° for a few hours ; it is soaked next in the hard paraffine mixture for about the same time or a little longer. It is very important that the temperature should not reach 60°. The actual process of imbedding takes place according to the well known methods. After the block is hardened in which the object is imbedded it is trimmed down into the proper shape, two of its surfaces are made carefully parallel, these are the two which are subsequently to be placed in the microtome parallel with the cutting edge of the knife. But the trimming of the block must not be completed yet ; the other two sides which need not be parallel, ought not to be cut down until later ; the parallel-sided block is now stuck down in the usual manner on to the object-holder of the microtome, and dipped in melted soft paraffine, so as to be coated completely by it, being held in the soft paraffine for some seconds, so that the surfaces of the block of hard paraffine may be somewhat softened by the high temperature, and so a more perfect adhesion be secured for the coating of the soft paraffine ; the block is withdrawn from its bath and allowed to cool, after which the coat of soft paraffine is carefully cut off on three sides, leaving a coat of soft paraffine only on the side which is to face the knife. If the coat of paraffine is observed carefully, it will be seen that at the corners of the block it is irregular, but the middle portion of the coat is of quite even thickness, while toward the edges of the block it is irregular in thickness ; if, now, the rest of the trimming of the block is done, these irregular corners will be cut off, and only the even portion of the coat will be left for use in the actual cutting. When the block is clamped in the microtome the surface having the soft paraffine upon it is turned towards the knife ; by adopting this method, it will be found that there usually is no difficulty in obtaining a ribbon of sections, each section adhering perfectly to its predecessor. If this method is used there is much less tendency for the sections to get caught on the blade of the microtome knife during the cutting, as is apt to happen when the block has been left coated on all sides or on two, since in the latter cases some of the soft paraffine gets rubbed on to the blade of the knife and there catches hold of the sections sufficiently to hinder the formation of a satisfactory ribbon. In order to get the two edges of the paraffine block exactly parallel, the apparatus devised by Prof. Osborne will be found convenient.

It is desirable whenever it is possible to color *in toto* beforehand. The safest staining fluid for this purpose that I have tried seems to be alum cochineal, which penetrates well, so that objects of

large size may be satisfactorily stained with it. I consider it desirable to supplement this staining with an additional eosine stain. For this purpose, after the parts have been stained in alum cochineal, they are left to soak in water for half an hour or so ; if this is not done, the subsequent use of alcohol will produce alum crystals in the interior of the tissues, and interfere with the cutting very seriously. After washing, the object is placed in an alcoholic solution of 0.5% of eosine and left over night, or in case of large objects even longer. For some tissues this staining is too intense, and it is necessary to put the object subsequently into alcohol to extract a portion of the color, at least from the outer part of the object, which may be over-stained, while the inner parts are not stained quite enough. By the second treatment with alcohol the over-staining is corrected easily; experience teaches one very soon the exact amount of washing out or extraction which each sort of tissue requires. When the nuclei are stained with logwood instead of with cochineal, the result is preferable, but logwood cannot be used except for small objects. Very good results may be reached with Beale's carmine, also with borax carmine, and it seems not improbable that safranine might be advantageously employed. Of course for special purposes, special methods of staining must be selected, according to the object. For general work, however, I regard staining with alum cochineal and eosine as the best I have tried. After the sections are cut, I find it best to arrange them at once in proper serial order on a sheet of paper; they may then be left in any place moderately warm and protected from dust, until it is convenient to mount them. For actual mounting I employ a method, which, in the precise form I have adopted, has not yet been described any where ; the material for fastening the sections is celloidine or gun cotton, dissolved in acetone. The use of acetone as a solvent was suggested, I think, first by Altmann. It is desirable to use pure acetone ; the ordinary commercial acetone is hardly good enough, but one can get pretty fair results with it. The solution is spread over the glass slide with a brush, and the slide held in a sloping position so that as much of the fluid as possible will run off ; when the coat is dry it should be almost perfectly transparent, and if there is any decided cloudiness or milky look about it, the solution is too thick and must be diluted with an addition of acetone, which must be carried so far that a coat on the glass slide can be obtained from it of the requisite transparency. When the celloidine upon the slide is thoroughly hardened, the sections in paraffine are laid out upon it in the desired order, then with the finger the band of sections are rolled. It will

be found that if the hands are entirely free from any greasy material and are perhaps a trifle moist from perspiration or from being breathed upon that by this method the sections will flatten out perfectly and will not adhere to the finger. If the sections do adhere to the finger, it indicates that the hand is not perfectly clean and should be washed with *hot* water and soap, and oftentimes with alcohol, for when the soap does not sufficiently remove the greasy material upon the fingers, alcohol will do so efficiently and quickly; in my laboratory, I am accustomed to washing the fingers with the old alcohol which has been laid aside for redistillation.

The slide with the rolled section upon it is dipped in perfectly clean alcohol of 96° and held there until the paraffine is thoroughly wetted, this can be seen by the changes of color; the slide is withdrawn from the alcohol and held in a vertical position so that the alcohol may drain off, after which the slide is then placed upright to dry; after drying the sections are covered by a second coat of celloidine, and when that is dry, the slide is warmed over a lamp very carefully just enough to entirely melt the paraffine; the slide is allowed to cool and the paraffine may now be dissolved out with turpentine and the sections are ready to mount.

For mounting it is indispensable to use exceedingly thin balsam. I recommend pure Canada balsam diluted with a large quantity of pure benzole. It is at this point that the inexperienced usually meet with their mishaps, for it is very hard to induce those accustomed to the ordinary methods of mounting to use balsam in sufficient quantity and sufficiently thinned out with benzole.

If the directions are followed the sections will keep their places perfectly; if they are not followed some of the sections are pretty sure to get torn or broken. This method of mounting I consider satisfactory except in one respect, that now and then there are little bubbles under the sections, the origin of which I do not quite understand and which interfere with the sections lying perfectly flat. But when the mounting is carefully done, most of these bubbles disappear in course of the manipulation, and for some unaccountable reason, the more familiar one becomes with the processes employed the more the bubbles stay away. If it was not for this one defect I should recommend the method quite unreservedly; it is essentially that which I learned from by friend Dr. Drasch of the Physiological Institute at Leipsic. It can also be employed when it is desired to stain the sections on the slide; for this purpose, the slide, after the paraffine has been dissolved by turpentine, is washed

again with pure turpentine, then placed in 96° alcohol, then in dilute alcohol, then in very dilute alcohol and finally in water ; the sections can then be stained in the usual manner, washed, dehydrated and mounted as before.

In conclusion, I should like again to say that there is scarcely anything in this paper which is original. The details have been selected from various sources, and a few slight modifications added.

HARVARD MEDICAL SCHOOL.

MORPHO-BIOLOGICAL CHARACTERISTICS OF THE GERM OF THE SOUTHERN CATTLE PLAGUE.

FRANK K. BILLINGS.

(Continued.)

IN general they appear either single or in pairs. In very old cultures these micro-organisms become thinner, more rod-like, and color more diffusely with the same degree of exposure to the tinction, and the whole substance is either not visible at all, or very faint. (Fig. 3.*) Again, such old cultures are very replete in apparent micrococci of various dimensions, which might lead one into the error of thinking that his cultures had become polluted. I call this last condition that of *coccoid degeneration.* (Fig. 3.) Or, we may see unusually long objects, the longitudinal diameter being twice or three times that of the mature organism, and the white or uncolored substance occupying a corresponding extensive amount of space, while the dark or colored ends may be somewhat larger or of the same size as those of the mature object. *This condition represents the first step in the development of these organisms, that is, they become longer, and more of this white substance is secreted.* (Fig. 4.) The next step in the process of vegetative development is the separation of one of the pole or coccoid ends, which then becomes free, and for a moment is exactly round like a coccus; and, as in a hanging-drop culture (to which I always add a very slight amount of an aqueous coloring solution), one will naturally see a very large number of these coccoid objects, on account of the fact that each individual present is continually going through the same process of multiplication. Here, again, one may see a condition or phenomenon that might be misleading. One of the coccoid ends having been separated, the other may still remain connected with the white

*See April MICROSCOPE.

material, and, as evidence that the colored ends have a greater degree of specific gravity as well as chemical composition, you will see, in the continual tumbling about and turning over and over of these objects, *a white, round, or nearly so, colorless object, directly under the eye, or numbers of these objects.* When the germs in such a hanging-drop culture have died from want of a sufficiency of nutrient material, you may see a large number of these objects, *which could be easily mistaken for spores.* But if we inoculate a new hanging-drop culture from the same material used to prepare the former, it will be found impossible to fall into any such serious error, for it will be easily seen that these non-colored, refracting points keep continually going out of sight, their place being taken by the coccoid, non-refracting point still attached to the other end of the white substance, and by watching one and the same organism in its continual turning over, first one appearance and then the other will be presented to the eye, until the second coccoid end has become detached. (Fig. 5.)

What becomes of the uncolored, transparent middle piece?

I do not know!

It appears, however, as if it underwent an almost immediate process of dissolution the moment it has become free from both of its polar attachments. That this substance does not represent a spore condition, or have any relation to spores, is to my mind entirely beyond all question, as I have searched most diligently for spores in old and fresh cultures and others, made at all kinds of temperatures, within the biological limits of these organisms, my search being inspired by the description *of what I now pronounce a forgery* of a germ, which represents a spore, as the cause of swine plague, by Mr. Salmon, in 1885, and again in 1886, as the cause of another porcine pest, to which Mr. Salmon now gives the name of "Hog Cholera." *This Salmon object does not exist, never has existed, and never will have any etiological connection with the American swine plague.* In my first published description of the micro-organism of the swine plague, I gave an erroneous description of the manner in which the coccoid-ends became freed from the white or connective substance. *This white, non-refracting, uncolorable material does not become extended to nothing and then break in two, leaving the coccoid ends with a delicate, colorless flagellum or spermatozoid tail, temporarily attached to one side,* as I then said, and as Detmers described it in 1880, *but the separation of these ends is direct and by sharp segmentation. Were it otherwise, we could not see the sporoid, colorless ends of so many of these germs when freed from their appropriate pole ends.*

TO PREPARE AMŒBOID CELLS IN THE INTESTINE.

V. A. LATHAM, F. R. M. S. (LOND.)

ABSORPTION.

TO study the process of fat absorption, kill an animal three or four hours after feeding it with fat meat, or a frog two or three days after feeding with lard. Put a very small shred of the mucous membrane of the intestine into

(*i*) 1 % solution of osmic acid; or,
(*ii*) A mixture of this with alcohol.
(*iii*) $\frac{1}{5}$ % solution of chromic acid, mix with osmic acid in variable proportion.
(*iv*) Absolute alcohol.

For maceration with a view to separation of the tissue elements, a mixture of glycerine, alcohol and ether in equal parts is employed, afterwards the cells are fixed and stained by a few hours immersion in $\frac{1}{2\,0}$ % solution of chromic acid made with sodium chloride instead of water, with or without the addition of a little osmic acid. After forty-eight hours maceration the tissue elements are easily isolated in large numbers, by simply tapping upon the cover glass after partially separating by teasing with needles. For preparation of sections either the freezing method has been adopted, or pieces of tissue (sometimes after further staining with haematoxylin) have been dehydrated with absolute alcohol and after being passed through turpentine have been soaked with paraffin, cut with the microtome and the sections mounted, by creosote-shellac method, in Canada balsam.

Examine tissue fresh, after being rapidly teased in sodium chloride or serum. Transfer some specimens to dilute Kleinenbergs' solution, and when stained throughout, embed in cacao-butter process; afterwards extract all the embedding agent from them by warm oil of cloves, first in spirit, and then in water, and finally mount in glycerine.

In the teased preparations in osmic acid and serum, many columnar epithelial cells contain fatty globules stained black by osmic acid, also in the numerous lymphoid corpuscles which are set free from the retiform tissue of the mucous membrane by teasing. Hence it may be inferred that the fatty matters are first taken up from the cavity of the intestine by the columnar epithelial cells; that they are then transmitted in some way from these to the amœboid lymph cells,

and these again convey them to and discharge them into the central lacteal.

The columnar epithelium in specimens which have been teased out after 24 hours, immersion in dilute chromic acid (1 of acid to 2,000 salt solution), it often happens that this striated border of the epithelium comes away from the cells in shreds. The most useful *stains* are iodine-green and carmine or picro-carmine, chloride of gold, nitrate of silver, logwood, eosin, etc.

PROCEEDINGS OF SOCIETIES.

WELLESLEY COLLEGE MICROSCOPICAL SOCIETY.

THE regular monthly meeting of the Scientific and Microscopical Society was held Saturday evening, March 24, the president in the chair. After the roll-call and reading of the minutes of the last meeting, Miss Gilchrist of the botanical department, gave an interesting paper on the "Dissemination of Seeds," illustrated by a large variety of seeds and fruits showing structure of appendages expressly designed to secure and facilitate transportation from place to place. A number of slides arranged for the microscope also illustrated the same subject. At the close of the paper the society adjourned and a short time was spent by the members and their guests in examining the slides placed under the microscopes, and the various seeds and fruits of larger size that had been used to illustrate the paper.

ST. LOUIS CLUB OF MICROSCOPY.

AT the meeting of this club, held April 3, the members reported on the examination of commercial cream of tartar for starch. Not one sample from drug stores contained this adulterant, while about seventy-five per cent. of the grocery store specimens were diluted with corn-starch.

J. C. Falk will entertain the club with some subject at the next meeting. The members will also report on the examination of powdered rhubarb.

Prof. Whelpley exhibited one of the Griffith focus indicators and recommended it for use when showing specimens to persons unfamiliar with the microscope, as they are liable to crush cover glasses unless some precaution is taken.

LOUISVILLE MICROSCOPICAL CLUB.

MEETING Tuesday, March 20. The president, Rev. C. J. K. Jones, in the chair. The regular business was discharged and the club resolved to go into working session. A number of objectives were examined; among them a $\frac{1}{12}$-inch first-class Bausch & Lomb objective recently received by Dr. H. A. Cottell. It was thoroughly tested on amphipleura, including the difficult one from Floyd County, Indiana. It proved a very satisfactory lens.

Some members of the club had the pleasure of entertaining Dr. Chas. Mitchell, of Nashville, Tenn., on Monday, the 19th inst. The Doctor had just received a new Spencer $\frac{1}{10}$-inch, 130° B. A. It was a beautiful working glass and the Doctor made it speak for itself. The Doctor was elected an honorary member of the club.

Contributions were received and acknowledged from the following persons:

Miss M. A. Booth, Longmeadow, Mass. Nine slides of recent and fossil diatoms, beautifully mounted and finished.

Dr. John Sloan, New Albany, Ind., twenty-four slides of named diatoms; mounted in his inimitable way.

SIMON FLEXNER, *Sec'y.*

SAN FRANCISCO MICROSCOPICAL SOCIETY.

THE regular meeting of this society was held January 12, 1888, with Vice-President Payzant in the chair.

Professor H. G. Hanks read an interesting paper on "Pectolite" a hydrous silicate of lime and soda. This mineral was discovered and described by Von Kobel in 1828, and he gave it the name which signifies "combstone," the name being suggested by its peculiar structure. The mineral is rather rare, having been found at but about eight localities in the world, until its recent detection in California. Pectolite has several varieties which Professor Hanks described. The occurrence of the mineral is very interesting. The first notice of it was given in the "Fourth Report of the California State Mineralogist," where C. H. Aaron found a single doubtful specimen in a boulder at the foot of White Mountain in Mono county. In the early part of 1887, a beautiful translucent, nearly white, rock was discovered in Tehama county, which was pronounced pectolite by Professor W. P. Blake, who was then in California.

The specimens to which Professor Hanks made special reference were recently received by him from George Senn, who brought it from Santa Barbara under the impression that it was asbestos. It was found in a mining claim owned by John C. Keyes, where it occurs in large quantities and could be taken out by the ton. The speaker noted especially the microscopic characters of the material. When handling it considerable annoyance was experienced from the prickly nature of the minute spicules or acicular fibres that enter the flesh like nettles, and being very sharp and small can only with difficulty be extracted. The microscope showed why this effect was produced. Each slender crystal breaks in a direction oblique to its sides, and this peculiarity of cleavage produces the keen-pointed needles that so easily penetrate the flesh and skin.

In the discussion which followed Professor Hanks' essay, Dr. Fredericks, of New York, gave an account of his mineralogical studies in Southern California. He reported finding kyanite at Carga Muchacho gold mines in San Diego county, near Fort Yuma. He remarked the resemblance between the occurrence of minerals at this location to that of Manhattan Island.

A LECTURE ON CANCER.

Dr. Douglas Montgomery gave an interesting lecture on the nature of cancerous growths, illustrating his remarks with blackboard drawings and excellent microscopical preparations. He pointed to the layers in which the malignant growth originates, traced its course and pictured its effects. The demonstration was clear, and was rewarded with a vote of thanks at its conclusion. A reproduction of the effort is impossible without the drawings and materials by which it was illustrated.

J. G. Clark exhibited a slide of the Edge Hill diatomaceous material donated by William Irelan of the Mining Bureau. The earth was seen to contain only the commoner forms.

A very interesting object was a slide of marine polyzoa, containing small corals. It was mounted by F. L. Howard, from materials received from Australia, and was shown by Mr. Riedy.

The society was in session until a late hour.

EDWARD J. WICKSON, *Rec. Sec'y.*

ELEMENTARY DEPARTMENT.

RUDIMENTS OF PRACTICAL EMBRYOLOGY.*

W. P. MANTON.

SECTION III.

PREPARATION OF THE EMBYRO.

§ 6. The egg †having undergone the required amount of incubation is removed from the incubator or nest, the marked surface always remaining uppermost (for the reason that the embryo lies on top of the yolk), and rested on a glass individual salt-cellar. A sharp rap is then given the larger end of the egg, so that the shell is broken, and air let in. The egg and cellar are then transferred to a dish of the salt solution which has been warmed to blood heat. The depth of the salt water should be sufficient to quite cover the entire egg. The upper part of the shell must now be broken by a few taps of the scalpel or scissors, and the pieces removed with fine forceps, over a space the size of a quarter dollar, or larger, according to the period of incubation.

This requires some little attention, as the sharp bits of shell are apt to turn inward and cut the embryo or open the yolk. When the shell has been taken away, the embryo will be seen lying within two rings (area opaca, area pellucida), or in the midst of a vascular spot varying in size according to the time that incubation has progressed. A circulating cut must now be made around these rings, with a pair of fine-pointed curved scissors—those used by oculists are the best—and the disk containing the embryo floated off and washed free from all adhering yolk, by gently agitating it with the forceps in the salt solution.

HARDENING.

§ 7. Previous to opening the egg a small glass dish—a sauce dish will do—should be prepared with a layer of wax, about a quarter of an inch deep, at the bottom. This is quickly done by pouring melted beeswax of the shops into the dish, and allowing it to spread out evenly. The dish is then partially filled with the

*Copyrighted.

†The egg of the domestic fowl is taken for illustrating the technique, and whatever is said applies to that; the eggs of all other species may be treated in essentially the same manner, varying slightly in detail. Thus a *holo-blastic* embryo, *i. e.*, an embryo from an egg which undergoes total segmentation,—(mammalian ovum) cannot be pinned out, as can a *mero-blastic* embryo, *i. e.*, an embryo from an egg which undergoes only partial segmentation (avarian ovum).

Kleinenberg or chromic acid solution,* the embryo transferred to it and the edges of the filmy membrane carefully drawn out and pinned down to the wax, so that the embryonic disk may harden without wrinkling or distortion. Any kind of pins may be used for this purpose, but the long German insect-pins are the easiest to handle, and are not so readily affected by the acid.

A. KLEINENBERG'S PICRIC ACID SOLUTION.—The embryo should be left in this undisturbed to harden, from 5 to 24 hours, according to size.

When this is accomplished, prepare a glass jar—a half-pint fruit jar or a tumbler will do—with 70 per cent. alcohol, in which a piece of cotton floats just below the surface. Upon this cotton place the embryo, and allow it to remain until the alcohol has withdrawn the picric acid, and the specimen has become whitened. It will sometimes be found necessary to change the alcohol once or twice before this is accomplished. When the embryo is quite bleached it may either be stained immediately, or placed at once in 95 per cent alcohol for indefinite keeping.

B. CHROMIC ACID SOLUTION.—The method of procedure is the same as that just given, except that the hardened specimen is transferred to a jar of water, instead of alcohol. When washed free from the acid—which requires some little time—the embryo is placed first in 70 per cent. alcohol, then stained—or placed in 95 per cent. alcohol for keeping.

A COURSE IN ANIMAL HISTOLOGY.

FRANK W. BROWN, M. D.

SECOND PAPER.

CONCLUDED.

PRACTICAL WORK.—(A.) With a clean knife-blade scrape the surface of the tongue or the inside of the cheek sharply. Place a small quantity of the scraping, not larger than a pin's head, on the slide, and add to it a drop of the normal salt solution. Mix thoroughly by means of a needle, adjust the cover-glass and examine with a $\frac{1}{4}$ or $\frac{1}{5}$ inch objective. In the field will be seen a number of cells packed together in masses. Avoid these and look more to the open spaces for isolated cells. As they are unstained, the untrained

*After some little experience with both of these hardening agents, I have come to greatly prefer the picric acid solution, for the reason that the specimen is rendered less brittle, and takes the stain much better than when the chromic acid is used. For some embryos the Kleinenberg solution is too strong and must be diluted with water. The formula as given does well, however, with chick embryos.

eye may at first overlook them, but with careful search, focusing the meantime slightly up and down, they will soon be discovered. Note the various shapes and search for the nucleus. This may more easily be found in the broad, flat cells, and is situated near the center. If the nucleus is not distinct, it may be brought out by the addition of a drop of dilute acetic acid to the specimen. This may be added without removing the cover-glass by "irrigating" the specimen as follows: At one edge of the cover-glass place a drop of the acid, then with a blotter absorb the salt solution on the side opposite the acid. The solution will be withdrawn from under the cover and the acid will take its place.

If it is desired to make permanent specimens of squamous epithelium, it can be done by taking a considerable quantity of scrapings and shaking them in a small test-tube in the salt solution. The epithelium is allowed to settle and the solution poured off and replaced with an ammonia carmine stain. They should remain in this for five minutes, when it is replaced with distilled water, which should be changed until the carmine is washed out. Now replace the water first with dilute alcohol and this with 95% alcohol. The epithelium should be allowed to remain in the stronger alcohol for several hours. With a pipette transfer a little of the epithelium to a slide, absorb some of the alcohol with a blotter and add a drop of oil of cloves. In five or ten minutes remove the superfluous oil and mount in balsam. This method is rather tedious, but gives most satisfactory results. The manipulations will have cleansed and separated the cells so that when stained they make beautiful objects for study.

(B.) When familiar with the appearance of squamous epithelium they may be looked for in the urine. Allow a specimen of normal, morning urine to stand for several hours in a bottle or test-tube. When sufficient sediment has collected transfer a little to a slide and cover. No salt solution is needed, the urine, under the circumstances, acting as a "normal" fluid. The cells when discovered will be found to differ slightly from those from the mouth. They are larger and more granular. The nucleus is large and clear. Many of the cells are broad and flat and belong to the upper layers. A few are somewhat larger, wedge-shaped and come from the middle layers, whilst others much smaller, inclined to be round and with very clear outlines are found in the lower layers. These cells can be stained extemporaneously by adding a drop of a solution of eosin to the specimen.

(C.) Take a scraping from the roof of a frog's mouth and examine in salt solution. The slide should be slightly warmed. The cilia on these cells can be seen in active motion. Study this motion carefully.

(D.) Scrape the tongue of the frog and examine in the usual way. These cells are columnar: rather long and thick. The nuclei can be developed by adding a drop of acetic acid.

(E.) Take a scraping from the freshly-cut surface of a liver; tease out in the salt solution and examine. These cells are polyhedral in form. They are highly granular, from the presence, probably, of an animal starch, and contain normally small fat globules. They contain from 1–3 nuclei, which are round and well defined, and seem to possess a delicate, structureless membrane.

(F.) Other organs should be cut and scraped and the cellular elements examined in the manner as above described.

EDITORIAL.

WITHIN the last few years a great advance has been made towards the pefection of the microtome. This advance has enabled the microscopist to do work which before was impossible. The writer was much impressed with this in looking over a collection of specimens made in his student days, a collection in which he took not a little pride. The majority of the sections were cut by hand after having been embedded, though not infiltrated with paraffin. The others were cut with a very primitive microtome. Very soft tissues, as lung, myxomata, etc., were treated very summarily. Too soft to be embedded, the art of infiltration unknown, they were simply squeezed with the fingers between two pieces of amyloid liver (a large supply of such liver being kept in a keg in the laboratory for the purpose) and cut by hand. With such methods the results could be anything but perfect. And yet the writer would not exchange many of the specimens thus manufactured with others made by good mounters of the present day, not because of any associations connected with them, but because they are better specimens. They are not so smooth, for occasionally the knife was "see-sawed" and left its trace. They are not so large, for to keep up a sustained, steady motion was impossible. But they at least have the merit of being moderately thick.

It seems to be the aim of many possessors of good microtomes

to cut their sections as thin as possible, and the boast is frequently made, that a certain number of consecutive sections have been cut from $\frac{1}{2000}$ to $\frac{1}{4000}$ of an inch in thickness. Sections having a thickness of $\frac{1}{2000}$ inch can be cut, providing the preliminary operations are carefully carried out; but, although the writer has had the opportunity of inspecting the work of many experts, he has not yet seen a section approaching a thinness of $\frac{1}{4000}$ inch, notwithstanding the claims made for a number of those examined.

The origin of this fashion of cutting over-thin sections is difficult to determine, for such sections are, in the great majority of cases, quite useless for any purpose of study, and the time involved in their preparation is as well as wasted. It is probably due to a desire to exhibit one's skill without regard for utility; something like that which induces one to write 10,000 words on a postal card, simply because some one else has succeeded in writing 9,000. Friedländer, in his excellent little manual of microscopical technology, raises the following objections to sections of extreme thinness. "1. They are manipulated with difficulty, and considerable time is often lost in spreading them upon the slide. 2. The various elements contained in the meshes of thin sections are very apt to fall out; and, as these are generally of extreme importance, the object of the examination may be defeated. * * 3. Structures which are sparingly distributed throughout an organ, as, for example, animal and vegetable parasites, are naturally more apt to be discovered in thick sections. * * 4. In thick sections definite stereometric conceptions of the structure of an object are frequently obtained, inasmuch as several superimposed strata are scanned directly, *in situ et in continuo;* while with the extremely thin sections plane images alone appear. * * " For sections of fresh organs he recommends a thickness of from $\frac{1}{500}$ to $\frac{1}{250}$ inch, for hardened preparations from $\frac{1}{2500}$ to about $\frac{1}{850}$ inch.

The rule should be then, not to make the sections as thin as possible, but rather to have them of a thickness that will include as many layers as can be clearly studied.

We hope that some readers will give this matter of thin sections a little study; for of the large number of mounts kindly sent us by our subscribers, the chief fault, when they have any faults, is generally that they are too thin to see anything worth studying. If the mounter will see that his sections are, so to speak, of the proper thickness, rather than thinness, we are quite sure that he will not be long in recognizing the results as far more satisfactory.

THE thirteenth annual report of the American Postal Microscopical Club is just at hand, and we learn from it that the usual amount of work has been accomplished by the society during the past year, in spite of absurd postal restrictions. One feature in the past year's work, however, has, to us, been disappointing—namely, the paucity of notes and comments in the note-books. As is well known, the club is not a money-making society, the receipts from membership fees all going to pay running expenses, it is an association of microscopists devoted purely to mutual help in this department of science. The slides sent out during 1886–87 have been as rule good, some of them meriting the term excellent, and have offered a wide field for comment criticism and suggestion. The few extracts from the note books republished in the report indicate how meagre these notes have been, and to what a limited extent members of the club have availed themselves of the opportunity of helping their fellows in the different circuits. We have before urged that the usefulness of this exceedingly useful club would be a thousand-fold enhanced if members would discuss the slides sent them more fully, and give their own experience with different methods of preparation, stains and mounting media, applicable to the specimen on the slide before them. In this manner valuable information would be obtained, and the whole guild of microscopists benefited. The *Journal* of the English Postal Microscopical Society has for its motto, "Knowledge is not given us to keep, but to impart; its worth is lost in concealment;" and we wish every member, not only of the American club, but also of the fraternity of microscopists would constantly keep this in mind.

ACKNOWLEDGMENTS.—From Henry Shimer, A. M., M. D., portraits of himself taken at different ages; from Dr. J. E. Reeves, one of the finest mounts of B. Tuberculosis in lung tissue that we have seen; from E. S. Coutant, interesting mounts of parasite from wing of osprey; and young, of long scale insect of orange; from Fr'. Dienelt, mount of spiracles of coleoptera lava; from Dr. Henry Shimer, mount of liver and lung of rabbit; from Dr. W. C. Borden, mounts of lung of five months' fœtus and kidney of frog, stained in alcoholic alum carmine; the slides show to advantage the beautiful effect of the above stain, the formula for which appeared in our March number.

TECHNOLOGY.

PHOTO-MICROSCOPIC STEREOGRAPHS.

"THERE are innumerable bodies in the world of small things," says the *Br. Jour. of Photo.*, "which can only be properly observed, so as to realize their configuration, by a binoclar microscope; and in the case of such objects, no matter how much they may be enlarged by photography in the usual way or with what perfection their detail may be rendered, they still afford a very inadequate idea of their form."

Our object at present is to point out, briefly, some methods by which the possessor of an ordinary monocular microscope may be enabled to photograph any suitable object with all the relief as seen in the finest binocular instruments, and this, too, without incurring much expenditure for costly appliances. Premising that the method to be described is intended for employment with low powers, we shall explain its principle of action by a simile we employed many years since, when we had occasion to introduce it to the notice of our readers of those days. Let a bust or a statuette be placed on a table at a distance of a few feet from a single, fixed camera, and a negative be taken. Now, without moving the camera, rotate the statuette on its axis in the slightest degree and then take a second negative. Prints from these two negatives will, when mounted side by side on a stereoscopic card-mount, and examined in a stereoscope, show the image in all the solidity that could be desired, the amount of relief being determined by the extent to which the original object was rotated previous to the second negative being taken. Reasoning from analogy, we now proceed to apply this system to the production of micro-stereographs.

The object-slide must not be placed flat down directly on the stage of the microscope, but upon a secondary or superstage so constructed as to allow of the small platform upon which rests the object-slide to oscillate from right to left within a limited sphere. The one we constructed for the purpose is made of thin brass pivoted at its two sides into guiding side pieces, the axis of motion being adjusted so as to coincide with the object to be photographed. Having focussed the object and using a diaphragm in front of the objective so as to increase its penetration, the first photograph is taken, when the little, see-saw slide holder is tilted to one side, after which it is tilted to the opposite side preparatory to making a

second exposure. The amount to which the tilting takes place must be only very slight else the apparent solidity of the image when subsequently examined in the stereoscope will be exaggerated.

Success in this is insured by employing an objective of small angular aperture, or, should it be too wide, limiting this otherwise excellent quality by a diaphragm cap being slipped over the end.

Another way by which stereoscopic photo-micrographs can be obtained by a monocular microscope is to employ an objective having an effectively large front lense, and covering it with an easy-fitting cap, having in it an aperture so much at one side as to cover up one-half of the lense. When making the first exposure the cap is turned so as to uncover one side of the lense and is rotated half a turn before taking the second negative; the resulting pair of pictures will be stereoscopic.

There are several other methods which may be employed and which are more especially adapted for the higher powers. This article is, however, mainly intended for the photo-microscopic aspirant with limited appliances."—*Scientific American.*

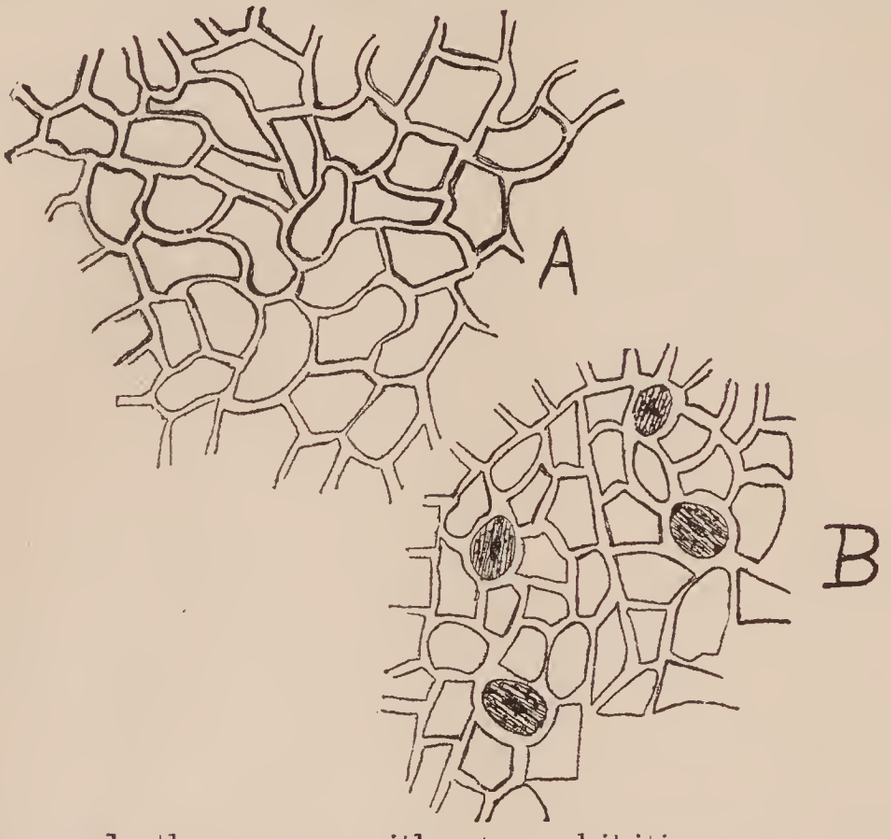
THE COMBINED USE OF CELLOIDIN AND PARAFFIN.—In the *Zeitschrift für wissenschaftliche Mikroskopie*, Kultschizky states that the use of both celloidin and paraffin in imbedding microscopical preparations has certain advantages over that of either material alone ; the individual parts of delicate objects preserve their proper relations; the preparation remains dry, and the process of making sections does not require the use of alcohol, and sections can be made as thin as when paraffin only is used. According to an abstract contained in the *Fortschritte der Medicin*, the method is as follows: The alcoholic preparation is allowed to lie for a few hours in a mixture of equal volumes of alcohol and ether; it is then placed for twenty-four hours in a solution of celloidin, the strength of which is immaterial. It is now placed in ordinary oil of origanum, subsequently in a mixture of paraffin and oil of origanum, which should not be over 104° F. in temperature, and finally in melted paraffin. The length of time that it should remain in the oil of origanum, in the solution of paraffin, and in the melted paraffin depends on the character of the object, and must be ascertained by trial.—*New York Medical Journal.*

ABSTRACTS.

CATHA LEAVES.

PROFESSOR FLÜCKIGER and J. E. Gerock contribute to the British Year-Book of Pharmacy for 1887 an interesting paper on Kat, its history, properties and uses. According to Botta, the virtue of these leaves is similar to that of the coca plant, and it is used in Yemen and other parts much as the coca is in the Cordilleras.

The leaves of the catha are leathery, of a dull shining green on the upper surface, pale beneath, entirely glabrous, and traversed by a reddish mid-rib giving off a system of veins running toward



the edges and the apex without exhibiting any remarkable peculiarity. The same applies to the anatomical structure of the leaf. Fig. A shows the epidermis of the upper surface of the leaf. Fig. B that of the under surface, which is provided with stomata

Fig. C is a transection of that portion of the leaf which is occupied by the mid-rib. The section shows the usual structial elements as met with in many other leaves, without any peculiar features. The leaves belong to that class provided with but one layer of "palissade cells," within the epidermis of the upper surface; in catha that layer is

built up of a double row of these vertical, elongated "palissade cells."

Catha Edulis is a glabrous shrub or tree, widely distributed in the interior of eastern Africa, from Abyssinia to Port Natal, and is largely cultivated throughout these regions, and also in the southern districts of Arabia. The leaves yield an alkaloid which has been denominated, provisionally, *Katine*.

DRAWINGS FOR PROCESS WORK. — Benjamin Day gives some excellent hints in the *Scientific American* in regard to drawing for process work. Every microscopist should know not only how to draw, with and without the camera lucida, but also how to draw so that his work can be reproduced for illustration; the suggestions here offered will be found of value. Mr. Day says: Drawings for process work are made on all kinds of Bristol-board, ledge paper, Whatman's drawing paper, grained drawing papers, such as Steinbach's, Day's grained, enameled, printed and embossed cards, photographic paper, plain Saxe or Clemen's leatherized, and heavy-coated enamel papers, such as Day's Scotch board. The implements used for coarse work are ordinary writing pens and for fine work Gillots' map pens, Crowquills' No. 290, Somerville lithographic pens, and Keuffel and Esser's lithographic pens. Some of the most beautiful line work can be drawn with a brush, such as is used by miniature painters, viz.: red sable No. 0 or No. 1, if it is trimmed down until but eight or ten hairs are left to form a point. There are all kinds of ready-ground drawing inks in the market, but none so good as freshly ground India ink, which can be ground readily, perfectly and absolutely black, in an ordinary saucer, and is the very best working medium that can be used for pen or brush work. Any ordinary saucer will do, and for an inkstand buy a common brass thimble to which fit a cork. Fill the thimble with water as a measure of the quantity of ink required. Pour this into your saucer and rub up your India ink until you think it sufficiently black. Then keep up the rubbing five or ten minutes longer. Now add one drop only of glycerine, and rub a little more, and the ink is made. To mount the inkstand, cut a potato or turnip in half, scoop out a hollow for the thimble, using the flat cut surface as a base for the inkstand, and when the pen fouls, jab it into the vegetable, which will clean it. To pour the ink from the saucer to the inkstand, make a long gutter of writing paper, by which it can be poured in without spilling a drop. Lithographic

crayons, No. 1 Lemercier's or Currier's, are used for drawing on the grained papers, and can be mixed with pen work thereon. By warming the back of a drawing made with lithographic crayons, they are fixed more firmly to the paper and made blacker. Drawings on enameled board are made more readily with a brush than a pen. Solid blacks can be painted in sparingly with a camel's hair brush. Pen lines run into these solids, infringing on the blacks, can be picked up with the point of a sharp scraper and carried into the solids, giving the effect of a wood engraving. This work can be cross-lined with a brush, giving the effect of white stippling. All drawings for process work should be pure black and white, even the finest lines. Their color is best ascertained by using a magnifying glass.

THE EXAMINATION OF WATER.—Dr. Parkes, of London, after reviewing the various methods of examining water, concludes that chemcal analysis, aided by microscopic examination, is sufficient, in the great majority of cases, to determine the amount of organic pollution of a water, and whether it is of recent date. In many cases the source of the pollution, whether from sewage or vegetable matter chiefly, can also be determined, but there is no possibility of ascertaining whether the water thus polluted is actually potent for evil or whether it may not be entirely harmless. Chemical analysis is powerless to deal with these cases of infinitesimal pollution of a pure water with infective material from the human body. Cultivation tests are equally powerless to cope with such cases. The only possible way of ascertaining the probable effects on the human system of drinking such water, is for the operator to perform the experiment on his own person—a course not likely to be pursued. The cultivation tests, as now practiced, add very little to the results obtained by chemical analysis. Micro-biology must undergo further development before germ-cultivation methods can be expected to throw much light on water pollutions. Lastly, the sanitary survey of the source of the water, or its mode of storage, should always be carried out whenever any doubt exists as to the freedom of the water from all possible sources of contamination.—*Med. News from Practitioner.*

SENSE ORGANS OF TURBELLARIANS.—Dr. L. Böhring has recently published (*Zool. Anzeigler*, 260) a preliminary account of the eyes, etc., of several species of planarians. In Planaria gonocephala each eye consists of a nervous apparatus and a pigment-layer, and the latter, unlike the eyes of Lang's polyclada, consists of many uncleated

cells united. The cavity of this pigment-layer is filled with end organs, each of which has a complicated structure, though this whole apparatus has previously been described as a hyaline structureless formation. Each end organ connects with a nerve-fibre, which in turn leads back to a unipolar cell of the optic ganglion. No lens is to be recognized in the sections. In Vorticerus auriculatus the two eyes (which lie directly on the brain) have the optic cavity divided into two chambers by a middle pigmented wall. Each cavity is filled by fine rods, having a central canal free. Around the margin of the capsule are numerous cells, which resemble ganglion-cells, and which send fibres to the rods, and hence are regarded as retina-cells.—*Am. Naturalist.*

THE MYCOLOGY OF THE FINGER-NAILS.—Some time ago we called attention to the observation of Kümmel and of Foster, on the methods of disinfecting the hands. Kümmel showed that this was a by no means easy matter, and recommended the use of hot water, soap and brush, with a five per cent. solution of carbolic acid. Foster found that the use of sublimate solution (1 to 1,000 or 2,000) gave the best results, but to this Kümmel does not agree. Now, Prof. P. Fürbringer comes forward (*Annals of Surgery*, February, 1888,) and shows that neither method necessarily touches the root of the trouble, for the tests of asepticity used, viz., touching or boring the finger into sterilized gelatin, did not take into account the micro-organism which may lurk beneath the nail. When the filth of the subungnial space was cultivated in proper media, various micro-organisms developed, and this occurred even if the hands had been previously disinfected by the best known methods. Fübringer extracted from the subungual space of such disinfected hands particles of matter almost microscopically invisible, and deposited them upon sterilized gelatin.

Assistants and chiefs of clinics were subjects of the experiments. Thirteen men were examined in this way, after they had most painfully and diligently disinfected their hands, fingers, etc. The time employed in these detergent labors varied from two to ten minutes. The solutions used were carbolic or sublimate, combined with soap. In only one case were no cultures of colonies of micro-organisms obtained.—*Medical Record.*

NEWS AND NOTES.

IF what the physical philosophers tell us, that our globe has been in a state of fusion, and, like the sun, is gradually cooling down, is true, then the time must come when evolution will mean adaptation to a universal winter, and all forms of life will die out, except such low and simple organisms as the diatom of the Arctic and Antarctic ice, and the protococcus of the red snow.—*Huxley.*

THE director of the patho-biological laboratory of the University of Nebraska, Dr. Frank S. Billings, announces that, although established entirely for investigation, the laboratory is to be made as useful as possible to the country. Hence he offers its advantages for purposes of instruction to boards of health, live-stock commissions and educational institutions — advantages which, he thinks, are better than any others of the sort in the country. Only two pupils can be accommodated at a time, and they must be medical or veterinary graduates who have the endorsement of some such body as those mentioned. The laboratory is situated at Lincoln.—*New York Medical Journal.*

THE examination in microscopy passed by the graduating class of the St. Louis College of Pharmacy, and published in the *National Druggist*, is a model of its kind. We are certain of 51 Ph. G.'s who know something of the use of the microscope.

A FUND of $10,000 has been offered by the family Cabot of Boston, the income of which is to be used as a salary for the pathologist of the Massachusetts general hospital. Dr. W. F. Whitney of the medical school, has accepted the position, with title of Assistant Pathologist.

THERE are six claimants to the discovery of the cancer bacillus. Germany has two, Italy two, France one and Brazil one.

SEAMAN, of Howard University, Washington, has secured information from more than twenty American colleges regarding the kind of microscopes used and the results of wear. The answers were, in a large majority, in favor of microscopes of American manufacture.—*Medical News.*

THE *Scientific American* for March 17 contains a well-written illustrated article on the Lick Observatory.

DR. W. G. FARLOW contributes an elaborate sketch of the late Prof. Asa Gray to the *Botanical Gazette.*

PROF. W. D. HALLIBURTON recommends (*Quarterly Journal of Microscopical Science*) the following as an easy way to get Methæmoglobin crystals: Defibrinate a few cubic centimeters of the blood of a rat, guinea-pig or squirrel, and add to it a few drops of amyl nitrite, and shake violently for a minute or two, or until the nitrite assumes a chocolate color. A drop of this is withdrawn with a pipette and placed on a slide, the cover-glass being applied immediately. In a few moments the methæmogloblin crystals will begin to form. By sealing the edge of the cover-glass, the crystals will remain unchanged a very long time.—*National Druggist.*

BOOK REVIEWS.

THE ART OF PROJECTING. A Manual of Experimentation in Physics, Chemistry and Natural History with the Porte Lumiere and Magic Lantern. By Prof. A. E. Dolbear, M. E., Ph. D. Lee & Shepard, Boston, 1888. Pp. 178.

The second edition of Prof. Dolbear's well-known work will be welcomed by all microscopists who are interested in the management and construction of the magic lantern. Light, lenses and projections are discussed in a popular but scientific manner in the first part of the work; the second and larger portion being given up to the demonstration of physical experiments. The book is well illustrated by silhouettes and wood cuts. It will be found to be a valuable addition to the working microscopist's library.

WALMSLEY'S ILLUSTRATED CATALOGUE OF PHOTOGRAPHIC CAMERAS, LENSES ETC.

We have just received part four of the eighth edition of this well-known catalogue, in which there have been some changes of prices and numbers. A full line of photographic instruments, materials &c., are here described, but the cameras which may be used in photo-micrography are of particular interest to the microscopist. We have elsewhere expressed our opinion that the Walmsley's improved photo-micrographic camera, with a Beck or Darlot lense, is the most useful camera for the physician's general use that we have seen.

THE INTERNATIONAL SCIENTISTS' DIRECTORY. S. E. Cassino, Boston, 1888.

The great labor necessary to the successful compiling of such a directory as this will be fully appreciated by those who have ever undertaken the collecting of even a limited number of names,—and that there are occasional omissions will not be wondered at. Mr. Cassino has rendered a service to all lovers of science in this new

edition of his directory, by thus facilitating correspondence with naturalists in all parts of the world.

NATURE'S METHOD OF CONTROLLING NOXIOUS INSECTS. By Henry Shimer, A. M., M. D. Reprint.

NOTES ON THE "APPLE BARK LOUSE," &C. By Henry Shimer, A. M., M. D.

THE PATHOLOGY OF HAY FEVER, by S. S. Bishop M. D. Reprint.

THE CORNELL UNIVERSITY REGISTER, 1887-88.

CORRESPONDENCE AND QUERIES.

COLUMBUS, OHIO, April 15, 1888.

EDITORS OF THE MICROSCOPE:

The last number of THE MICROSCOPE (April number), contains "Notes on a Fasoldt Test-plate," by Dr. R. H. Ward, the same plate I suppose, which Mr. Fasoldt presented to the A. S. M. two years ago. At the Chautauqua meeting, in 1886, Prof. Burrill, then president of the A. S. M., appointed a committee of three, composed of Dr. R. H. Ward, Dr. Blackham and myself, to examine the plate, and to report the result. Although this committee was appointed nearly *two* years ago, I have never yet seen the plate, and consequently can neither examine the same, nor report on it, and do not even know who has it in his possession and withholds it from the committee. Will you, through THE MICROSCOPE, please ask the possessor of the already famous plate to rise and explain, and to deliver the plate?

Yours truly, H. J. DETMERS.

EDITORS MICROSCOPE:

In the January number of the MICROSCOPE appeared an editorial upon the condition of our microscopical societies in general. I am very forcibly impressed with the truthfulness of your charges, especially when you say: "That the majority of the members of local societies are those who, without any special training, have accidentally or otherwise become interested in microscopy, bought a microscope, and have joined a society to learn how to use it."

I am going to take the liberty to make the above a pretext for drawing the attention of your readers to a fact which has a more or less bearing upon the subject.

I am inclined to believe that this apathy, into which so many members fall, is very largely due to a want of knowledge of how to prepare even simple objects for examination. It is a fact to be deplored, that so few men can be found who are able and willing to

give instructions in microscopical technology. I am sure that every microscopical society in the U. S. has a number of members who would gladly take advantage of such an opportunity, were it offered. Now, I am informed that such an opportunity has recently been presented to the different societies of this country, by Mr. Arthur J. Doherty, of Manchester, Eng. One would suppose that Mr. Doherty's work and skill is so well known that special advertisement is unnecessary, and that he would find no difficulty in making engagements in a country where just such information as he offers is so much sought after.

However paradoxical it may seem, Mr. Doherty writes me, that he has received invitations, so far, from only three societies. He states further that he will be obliged to give up the project of coming to the U. S. to give instruction in section-cutting, staining, preparing and mounting objects for microscopic study, unless a greater number of societies can be induced to accept his offer.

The Denver Microscopical Society is one of the three societies which has decided to take this course of instruction. I merely mention this, however, for the purpose of illustrating its effect. As soon as it became known among the members of this society that such an opportunity would be presented, new life seemed suddenly to pervade the whole society. Members who had not attended the meetings for months, eagerly subscribed themselves as members to this course, and expressed great pleasure that such an opportunity was expected. The truth is, they had lost interest in microscopical study, just because they did not know how to prepare the objects properly.

I suppose that I may assume our members to be representative of the average membership of most of the societies of this country. In all of them there are a few who do most of the work, and many who have joined out of curiosity, and a desire to learn and see what the workers do. The latter are the ones whom a course of instruction, such as is offered by Mr. Doherty, would change into enthusiastic and useful workers. Is it not possible to stir up enough interest in this matter that more societies may decide to accept Mr. Doherty's offer and thus insure his coming to this country?

H. F. WEGENER,
Prest. Denver Mic. Soc.

For the information of those who may not know Mr. Doherty's terms I may add, that he charges ten dollars for a lesson given to a class. If the class consists of ten members, it will cost each member one dollar a lesson. That is the way we understand it.

EXCHANGES.

This department is for the benefit of SUBSCRIBERS *who have microscopical apparatus, material or books which they wish to exchange, and such wants will be* INSERTED FREE OF CHARGE. *The number of insertions given will depend upon the number of exchanges received each month. Subscribers will please notify us when articles have been exchanged or sold. Dealers are referred to our advertising department.*

FOR SALE—A Tolles 1-12 in. objective, a very fine lense and practically new, having been used only a few times. Cost $100, and will be sold for $60.
Address, E. K. BAXTER, Sharon, Vt.

SLIDES FOR EXCHANGE—Peristomes of Moss and Diatoms, for miscellaneous mounts and material. Address, Dr. E. D. BONDURANT, Tuskaloosa, Ala.

FOR SALE OR EXCHANGE—Vols. I to VI inclusive, of Phin's American Journal of Microscopy, vols. I and II bound, price, $4.00. Wanted Langley's The New Astronomy Slides. E. CROCKER, Berea, Cuyahoga Co., Ohio.

SPECIMENS OF UTAH ROCKS AND MINERALS; also natural deposits from the mineral lakes and springs of Utah and Idaho, in exchange for good mounts.
Address, PROF. J. E. TALMAGE, P. O. Box 75, Provo City, Utah.

WILL EXCHANGE COLE'S STUDIES IN PATHOLOGICAL HISTOLOGY, Vol. III, for Cole's Studies in Animal Histology. Vol. II or IV. I offer full text and 12 slides and desire the same in exchange.
A. B. AUBERT, Maine State College, Orono, Maine.

FOR SALE—A Bausch & Lomb "Professional" Microscope, complete, nearly new. Catalogue No. 561; list price, $185.00. Best offer wanted—— ——?
J. H. SMITH, M. D., 909 S. Charles St., Baltimore, Md.

FOR EXCHANGE—Synopsis of the Diatoms of Belgium, by Dr. Van Henrck, 132 plates unbound. Will sell, or exchange for an Abbe Condenser, or a good laboratory microtome and pay difference in cost. F. J. SCHAUFELBERGER, M. D., Hastings, Neb.

FOR SALE—Slide of Bacillus Tuberculosis (from Sputum) single and double-stained.
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FOR EXCHANGE—Diatomaceous earth from the plateau of Thibet (12,000 feet) varieties localities; also material and slides from localities in Scottish Highlands. Wanted, slides of American Diatoms, Insects and Botany.
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WANTED—Parasites and books on Parasites and other micro-subjects; will give Anatomical, Pathological, Botanical, Microfungi, Zoophytes, Polycistina, Foraminifera, Parasites, and other slides in return. Shall be glad to open an exchange at any time with micro-correspondents for any of the above subjects.
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I HAVE a good "Little Monitor" local telegraph sounder and straight lever key (cost new, about $6 to $8), both in good order; also, a Wirt fountain pen (one of the best made, cost $2.50, good as new, having been used but very little; one copy, in cloth, of "Parson's Handbook of Business and Social Forms," 500 pages, $3.50; never used. I wish in exchange latest editions of Beale's "How to use the Microscope," "The Microscopist," by J. H. Wythe: Rev. W. W. Spicer's translation of Johann Nave's "Handbook of Collection, Preparation, etc., of Algæ, Diatoms, etc.," or other microscopical works. Correspondence solicited. F. W. DUNNING, 32 So. Division St., Battle Creek, Mich.

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ORIGINAL COMMUNICATIONS.

A NEW MARINE LARVA AND ITS AFFINITIES.

J. WALTER FEWKES.

[PLATE VI.]

THERE are in the waters of the Atlantic, near the coast of the United States, a large number of marine larvæ, very different from characteristic larvæ of the European seas, of the adult of which the naturalist is in profound ignorance.* The adults of these larvæ may have been described and figured, may be well known, but from the fact that many young marine animals are so different from the adults, their relationship is unsuspected, although both mature and immature stages are known. It is certainly a desirable thing to trace these larvæ to their parents, as a part of the great study of the metamorphosis of marine animals. This special line of zoölogical work has many attractions to an earnest band of working naturalists, and offers remarkable possibilities for discovery. The same branch of marine research has been prosecuted for many years on the shores of the North Sea and the Mediterranean, and a large number of larvæ, known to be such, but which have as yet not been raised into adults, have been described and figured. This provisional nomenclature of a larval animal known to be such has been a means of attracting the attention of other naturalists to the larva, and in many instances has led to the discovery of the adult.

The larval forms of marine animals of the coast of New

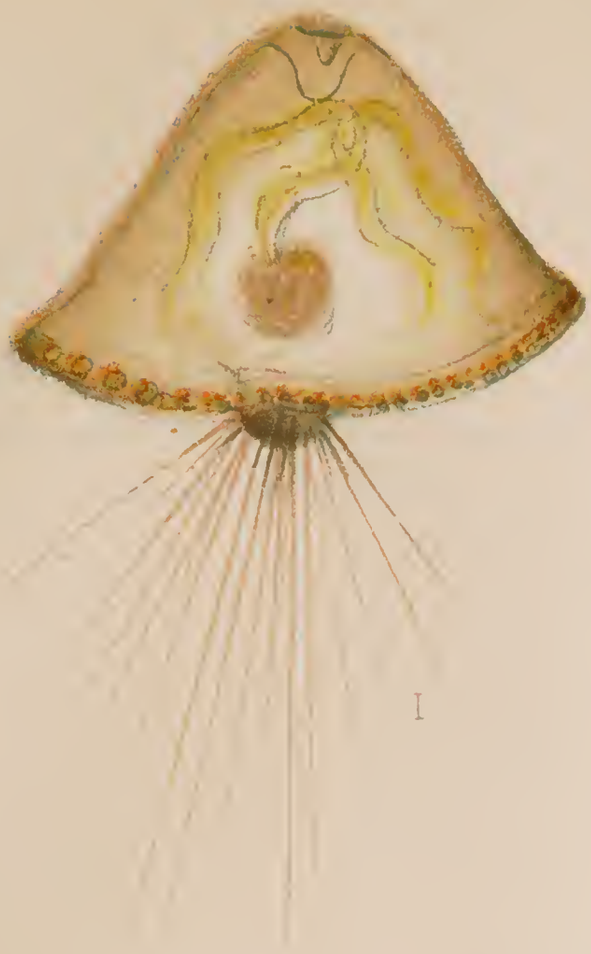
* Conversely. also, we are ignorant of the young of a much larger number of adult animals of our seas and bays.

England are varied in form and rich in number. They are as different from those of Europe as the fauna of our bays and sounds is different from the European. We have few descriptions of these larval animals from our waters, and so different are they from the European that it is hard, almost impossible, to identify them. Shall we give these undoubted larvæ new names which shall be provisional, or shall we delay publication until we have traced them to the adults? Something is to be said in favor of both courses, but a description of a new stage of a larva by one observer may attract the attention of another naturalist, and fit into a series of observations otherwise complete, thus leading to a discovery which neither alone could possibly make from the material at his command.

The object of the present paper is to record a brief notice of an unknown larva of peculiar morphology, found in the Bay of Fundy. Its general affinities are apparent and will be spoken of later, but its special relationship is unknown. It is hoped that this mention may meet the eyes of those interested in the study of the metamorphosis of the marine animals of the United States, and attract the attention of some one who may be able to add to our limited knowledge of it. No more interesting questions can at present be raised, as far as the determination of the facies of our marine fauna is concerned, than those which deal with the identification of the larval forms of life which inhabit the populous waters of our coast.

A number of naturalists have expressed the belief that the larvæ of some annelids are closely related to the young of certain bryozoa, and have supposed that the phylogenetic history of the two groups is closely interwoven. A young Chætopod, which combines many characters of the larvæ of the Bryozoa, is called Mitraria. While several of the features which distinguish this larva are undoubtedly secondary modifications, and are of little phylogenetic importance, the general form of mitraria is believed to approach closely the prototype or ancestral form of both the chætopods and bryozoa, if not of the brachiopods and other related groups. It is the purpose of the present paper to consider the form of a larva allied to Mitraria from the Bay of Fundy, and to call attention to the interest attached to the study of this interesting animal.

A true Mitraria has never been described from the coasts of North America. I have found specimens of this genus at the Bermudas and at Santa Cruz, California, but neither of these have been figured or described. No other naturalist has recorded Mitraria from American waters, and but few have found it in European seas.



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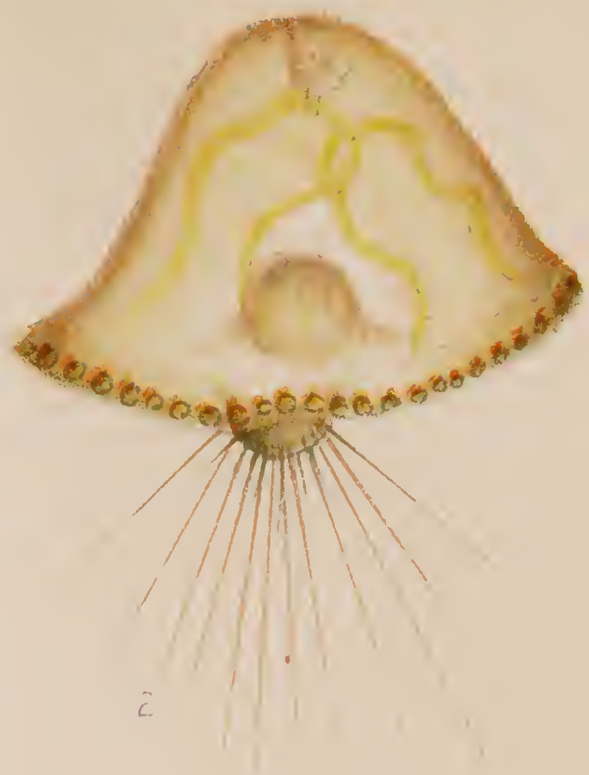

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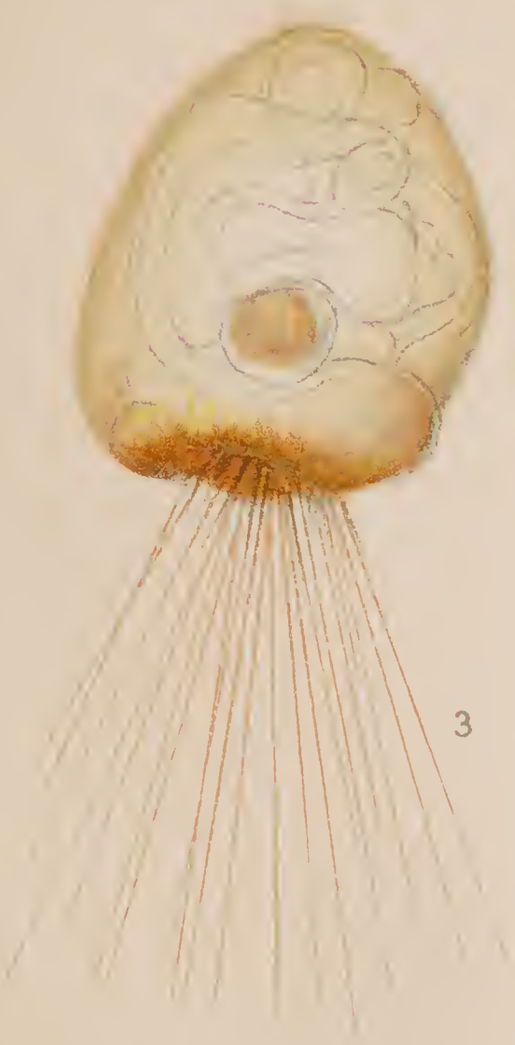

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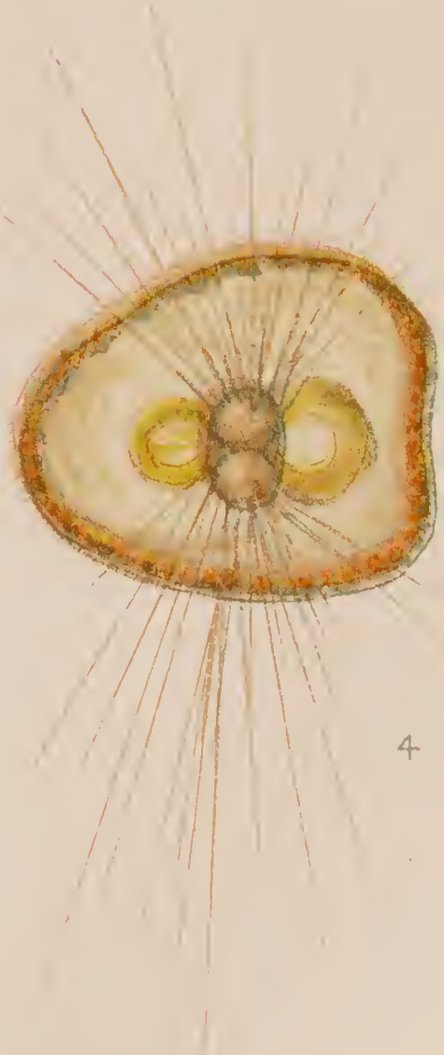

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PLATE VI.

It is consequently with great pleasure that I am able to figure for the first time a beautiful Mitraria-like larva, which is found in abundance in the cold waters of the Bay of Fundy. This larva does not occur south of Cape Cod, although it is represented in the waters of Massachusetts Bay, at Provincetown, Mass. It is different in form from the European representative of which in truth, considering the part which it has played in discussion of the affinities of larval forms of animals, too little is known.

My new larvæ was first taken by means of the drag-net or tow-net, in the summer of 1886. I first found it at Frye's Island, New Brunswick, and afterwards it was taken at Grand Manan. The larva occured in countless multitudes in July, and later decreased in numbers and was collected far into August. Later than August however, I have never seen Mitraria in the nets, although it may and probably does last long into the autumn. The following lines will give an idea of the general contour and structure of the body of my new larva.

The body (Pl. I) is hat-shaped, with a narrow rim, gelatinous and transparent. When contracted the æquatorial rim or belt of the worm is drawn to the body imparting a spherical form to the animal. The contracted form of the larva is seen in Fig. III; the expanded in Figs. I and II.*

There are two ciliated regions of the body. One of these is situated at the apex of the larva, forming a small tuft of cilia shown in the figs. I, II and III. The second ciliated region is found on the rim of the larva, forming a belt, skirting the outer border. This second region or ciliated belt is conspicuous on account of the masses of reddish pigment shown in the figures.

Hanging down from the pole of the larva, opposite the apical tuft of cilia, there is a bifid protuberance from which arises two fan-shaped bundles of provisional setæ. These setæ resemble embryonic setæ so common in larval chætopods. They can be drawn together or separated and are always very conspicuous. Above the protuberances from which the spines arise, there is a spherical, darkly pigmented body easily seen through the walls of the larva. (Figs. I, II and III.)

Under the apex of the larva there is a thickening of the epiblast which is connected with the marginal belt by means of a fine thread, shown in figs. I, II and III. The apical tuft of cilia rises from

*In the figures of the plate accompanying this paper, Fig. I is a view of the Mitraria-like larva from one side. Fig. II. The same. Fig. III. Lateral view of larva with the marginal rim contracted. This is a common attitude assumed by the larva when at rest. Fig. IV. View of larva from lower pole.

this epiblastic thickening. The digestive system of our larva is very simple, and its yellow walls are readily seen through the sides of the body. It consists of a long, tubular œsophagus, the inner wall of which is richly ciliated, opening into an elongated stomach, simple and without cilia.* The mouth lies just inside the ciliated rim or belt, and is separated from the stomach by the globular body, at the base of the spine-bearing protuberance on the lower pole of the larva.

The larva is, when expanded, from .15 to .2 mm. in diameter.

Only a single stage in the growth of this larva was found, and consequently its adult form is unknown.

The question now arises, what are the affinities of the curious larva described above. It has chætopod, brachiopod and bryozoan features, and may be supposed to resemble the architype or ancestral form of these three groups.

I was at first led to regard it the young of the genus terebratulina,† a brachiopod common in the Bay of Fundy. It differs however, very considerably from any figure of a brachiopod which I have ever seen, although in some features it recalls Argiope. It also resembles somewhat Cyclopelma, the young of Loxosoma often-times regarded a bryozoan. Its closest affinities apppears to me to be with Mitraria, a larva which Metschnikoff has already shown to belong to the developmental stages of a chætopod annelid. It differs however considerably from Mitraria and its true affinites, whether with brachiopods or chætopods, must be discovered by later investigation.

Balfour, in his well known Comparative Embryology, has sagaciously suggested that Pilidium, a larval form of certain nemertean worms, reproduces the larval prototype in the course of its conversion into a bilateral form. Other naturalists have carried the idea still further, and find the Pilidium to represent a definite stage in the development of several groups of marine larvæ. While I cannot subscribe to many of the statements made by the several naturalists who have written on this subject, it seems to me not improbable that Balfour's interpretation of the signification of the Pilidium as a definite ancestral stage may be considerably amplified, and that the Pilidium or a Pilidium-like larva may be recognized in other groups than that of the nemerteans. The well-developed Pilidium is probably more or less modified by secondary characters, but the essential form of the young Pilidium is probably ancestral for several groups of marine animals.

* No external opening of the stomach through an intestine was observed.

† It cannot be asserted dogmatically that my new larva is not a brachiopod; it differs essentially from the larval brachiopod which have been described.

Following the pilidium stage in the groups of Brachiopods, Chætopods and Bryozoa is one which we may call the mitraria stage. It is thought to be assumed, possibly in a modified form but with certain general features which are characteristic, by the young of certain genera of each of the three groups mentioned.

It is the opinion of the author that while the beautiful Mitraria-like larva here figured has many secondary characters which are not ancestral for the Bryozoa, Chætopoda and Brachiopoda, it also has features which are phylogenetic for the three groups. Considering, then, the Pilidium as a stage following the gastrula, the next stage in these groups may not be unlike the Mitraria. This stage, which may be looked upon as a common one in the three groups named, adds to the gastrula, among other features, the following: 1. An apical tuft of cilia mounted upon an epiblastic thickening; 2. A mouth surrounded by a ciliated rim; 3. A protuberance near the mouth from which arise embryonic setæ.

While undoubtedly some of the characters of the Mitraria indicated above are secondary and special adaptations of limited distribution, it is believed that the majority are ancestral for Brachiopods, Bryozoa and Chætopods, and that the common ancestor of these three groups is most closely preserved to us in the genus Mitraria. I therefore suggest as a name for the common ancestor of the Brachiopods, Chætopods and Bryozoa, that of Mitraria which up to the present is applied simply to the larval form of a single genus of Chætopoda.

MUSEUM OF COMPARATIVE ZOOLOGY, CAMBRIDGE, MASS.

HOW TO PRODUCE HÆMOGLOBIN OR HÆMATO-CRYSTALLIN.

DR. S. WATERMAN.

[PLATE VII.]

BEFORE we proceed to consider the various agents by and through which blood is altered, and its optic appearances presented when thus altered, it seems to me of great importance to state how the hæmato-crystallin can be obtained. To this part of our essay I call your most concentrated attention. We have already stated, that these crystals are not found preformed in the blood, but are conjugated to an alkali, most probably to the carbonate of potassium. To obtain them, therefore, this combination must be first broken up, or disassociated.

The subject is full of stirring interest for the microscopist as well as for the spectroscopist. One of the most interesting facts well ascertained is, that in fish blood we often find blood corpuscles with a crystal "intra-globular," and which, on addition of water, resumes its normal form and condition again. This extraordinary phenomenon became a subject of widespread controversy. But the same "intra-globular" appearances were demonstrated in 1857 by Bissegger and Bruch at the meeting of the Physical Society, assembled at Basil, Switzerland.

Whilst hæmoglobin, or hæmato-crystalline (and we shall, in future, use the first term on account of its brevity), is the normal crystallizable material of blood, there are other blood crystals directly derivable from blood that has been acted upon by chemical agencies, and are mostly products of decomposition or chymolisis. Such are, firstly, the "hæmin," and Lehman's hæmatin, that seems to be identical with hæmin; also hæmatoidin, which appears in beautiful oblique rhombic forms, and is one of the most frequent of metamorphic products spontaneously formed in the body out of hæmatin (perhaps more properly out of hæmoglobin), and is found often in such large quantities that it may be perceived by the naked eye. The crystals appear in a brilliant yellowish-red color. When present in larger masses they present a deep ruby-red color, and form, according to Virchow, the most beautiful crystals with which we are acquainted. Prof. Virchow says ("Cellular Pathology") a man must be a keen observer, or else he will fail to discover in the spots where the hæmatoidin is lying, any more than an apparently shapeless mass.

This substance is probably changed hæmoglobin, not altered hæmatin, as Virchow has it.

An apoplectic effusion in the brain cannot be repaired by any other process than by blood undergoing this transformation into hæmatoidin. Virchow also believes that when a young woman menstruates and the cavity of the grafian vesicle becomes filled with coagulated blood the (hæmatin?) hæmoglobin is gradually converted into hæmatoidin, and we afterwards find, at the spot where the ovum has lain, the beautiful, deep-red, oblique rhombic crystals as the last memorials of menstrual episodes. In this manner we can demonstrate apoplectic attacks in the brain, and calculate how often the menstrual process has taken place. Often this is of great importance in forensic cases.

These crystalline deposits of hæmatoidin possess the

greatest staying powers within the interior of any organ. Virchow errs certainly here in two ways. Hæmatoidin is derived directly from the decomposition of hæmoglobin, and not from hæmatin, which is already a product of decomposition. Secondly, the crystals found in the ovaries after the rupture of a grafian vesicle are not hæmatoidin, but a crystalline substance *sui generi*, which is now known as lutein, and which has a crystalline form of its own, as we shall show later on.

Hæmin crystals are produced artificially, and as such are of the highest interest *when we are called upon to prove the presence of blood.* I hold these hæmin-crystals to be simply a kind of hæmatin, produced by the action of acetic acid upon the blood.

MODE OF OBTAINING THE BLOOD CRYSTALS.

The production of hæmoglobin crystals is surrounded at times with more or less difficulty. When we remember that hæmoglobin so readily decomposes, this need not be wondered at. Often we succeed in obtaining these crystals in an impure state, and re-crystallization is necessary. It is also difficult to filter a blood solution, and we will often fail before we learn how to proceed in the matter successfully. It requires, in short, experience to produce fine, large crystals, which depend upon concentration of the solution, access of air and proper temperature. Let us remember here once more, that hæmoglobin is not ready-formed in the blood current, except under certain rare pathological conditions ; that it is conjugated there to an alkali, and that, in order to obtain it crystallized, this combination must be broken up. We also must remember that this crystallizable albuminoid is readily decomposed during the chemolysary process.

Blood, to be manipulated to produce crystals, *should be freed, as far as possible, under low temperature, from serum and fibrin.*

The simplest means to dissolve blood is water. We allow the blood to coagulate, express the serum, and the fibrin is separated by filtration. Through this solution we direct a current of oxygen for half an hour, then carbonic acid for ten or fifteen minutes. Crystals are thus readily obtained from the blood of the guinea-pig, rat and mouse. To obtain crystals from the blood of the dog and other animals, alcohol in small quantities is added during the passage of the gas currents.

A second mode, employed by Rollett, is freezing of the blood, which is previously freed of its fibrin by beating with small twigs. Half an hour exposure to a freezing temperature suffices. We set the frozen mass aside in a cool place and allow it to crystallize for

fifteen to thirty minutes. Crystals may thus be obtained from the blood of the guinea-pig, the squirrel and the cat. Dog blood requires more time. Most time is required by the blood of man and the hare. *No crystals are in this way obtainable* from the blood of the swine or the frog.

Another practical way to obtain crystals is to employ dog blood. Defibrinate and mix water in equal parts to each volume of blood, and add to four volumes of the blood solution one volume alcohol. Set the mixture to rest for twenty-four hours at a temperature of 0° or less. The crystals will form, are filtered off, pressed, solved in the smallest quantity of water, say 25 to 30 per cent., exposed to a temperature of 0°. This solution is mixed again with one-fourth of its volume of alcohol at a temperature of 0°, or perhaps better at 10 to 20°, and left undisturbed for twenty-four hours. The whole solution is converted into a crystalline mass, without the freezing of the water.

There are other methods to obtain the blood crystals in large quantities, but this will do for the present. More detailed accounts can be found in Preyer's work, "Die Blutceyatallo von W. Preyor, Jena."

PRODUCTION OF BLOOD CRYSTALS IN SMALLER QUANTITIES.

1. Warming the blood up to a temperature of 60°, we obtain a dark-colored solution, each drop of which, on slow evaporation, will yield crystals. In this way we may obtain crystals from blood of the guinea-pig, and from horse blood. (Max Schulze.)

2. By adding a small amount of ether to the cold blood solution (of dogs), and then gradually warming, and afterwards cooling at a low temperature, furnishes the finest crystals in the shortest period of time. (Preyer.)

3. The constant electric current carefully applied will produce crystals from the blood of man, cats, dogs and guinea-pigs. (Rollet.)

4. When a glass balloon is filled with dog's blood, into which air, highly heated, is introduced, and is left to stand at 30°, under exclusion of air, it is found after the lapse of four to six weeks that the air above the blood has lost nearly three per cent. of oxygen and gained an equal percentage of carbonic acid. An enormous quantity of crystals of hæmoglobin has formed in the meantime. (Pasteur.)

5. By directing a current of air (previously passed through a small quantity of chloroform) through defibrinated blood, every drop furnishes crystals on evaporation.

PLATE VII

6. The addition of chloroform, alcohol and ether is successfully employed to furnish crystals. (A. Schmidt, Kunde.) These physicists mixed fresh dog's blood with one-half to two-thirds of alcohol, and left the mixture to itself. After a time it abounded in crystals. Ether acts very much like it. Dog's blood is defibrinated, shaken with ether which is added drop by drop; left for twenty-four hours, every drop will, under the microscope, reveal blood crystals.

7. We may obtain crystals by exhausting the blood of its oxygen, either mechanically or chemically. Even the blood of man furnishes microscopical crystals. The blood of suffocated persons, whether by strangulation, or those that perish in mines from fire-damp, or accumulated carbonic acid, or carbonic oxide gases, probably also the blood of persons perishing from the various anæsthetics, will yield a rich harvest. In case of mechanical obstruction to the admission of oxygen, and consequent suffocation, there are some points not yet fully cleared up. The blood of such persons, when shaken up with oxygen, will show the two bands of oxyhæmato-crystalline—a sufficient proof that unless a chemolysis of the blood has taken place the hæmoglobin, although crystallized, would yet behave, under the prismatic test, in the same manner as blood does.

8. The briefest way to obtain crystals from all bloods, is the following: Take four cubic centimeter of defibrinated blood, mix with equal parts of water, or until the solution has become clear. Very often a drop of the mixture placed upon a slide, covered with a thin cover, on evaporation will yield crystals. The addition of a minim of alcohol or ether, and exposure to evaporation at a low temperature, will seldom fail to yield abundant crystals.

The appearance of blood crystals in the living animal organism must always be looked upon as a pathological condition, especially those that are the result of disassociation or chymolysis. There is only a solitary exception to this rule, to-wit: in the rainworm does this crystallizable albuminoid appear in a solution by itself, and the crystals form by simple evaporation of its vital fluid. When, from any cause whatever, the blood mass loses its alkalinity and assumes an acid reaction, the decomposition of hæmoglobin is thereby greatly favored, the normal combination of hæmoglobin and its alkaline basis is broken up, leaving this substance free and in a favorable condition to assume its natural crystalline form. Gout and rheumatism favor this chymolitical process, and the blood of

gouty and rheumatic people is prone to decomposition; for it is a well known law that the action of any acid upon the blood, with the single exception of carbonic acid, destroys its integrity, and especially its hæmoglobin. We have already mentioned that *in the living body hæmoglobin is joined to a potassium carbonate.* If even a large quantity of an aqueous solution of carbonate of potassa is mixed with a solution of hæmato-crystalline, we obtain a clear, transparent mixture without turpidity, change of color, and without modifying the spectral bands.

Considerations of this kind allow us an insight into the innermost recesses of blood life, and we at once understand how it comes that carbonic acid is so amply present in arterial blood, in spite of the oxydizing power of a superabundant quantity of oxygen present.

The individual acts of respiration are of too short duration to make the expulsion of the entire volume of carbonic acid a matter of possibility. A certain given quantity will, therefore, at all times remain unexpired.

At first sight, this would seem highly dangerous to life, but nature has made ample provision to avert this supposed danger, and to apply this surplus to some wise purpose in the economy. She assigns to this irrespirable gas the important task to assist in the conservation of the hæmoglobin, by employing it to form potassa carbonate, for which said hæmoglobin has so strong an affinity, using the resulting free oxygen for purposes of oxidation, and by this interesting exchange or metabolism, restoring the normal status of hæmoglobin.

Certain morbid conditions favor a disposition of the hæmoglobin of the blood to crystallize in mass, either directly after the death of the animal, or when blood is abstracted during life. In this direction we have Brown Sequard's highly interesting observations. He states that after *ablation*, or extirpation of the supra renal capsules of animals, the blood of said animals, either shortly before their death or directly after it, showed an irresistible tendency to crystallize spontaneously, so that one drop placed before the microscope would cover the entire field of vision with a network of crystals, like numberless fine needles crossing each other.

What bearing may these observations have upon Addison's disease, being a disease of the supra renal capsules? The peculiar bronzed color of the skin may possibly depend upon an alteration of the blood coloring matter; for in one case under my own observation and treatment, of Addison's disease, associated with bloody urine,

the spectroscope gave the bands of reduced hæmatin. (See diagram No. 5.)

REDUCTION OF THE QUANTITY OF HÆMOGLOBIN IN VARIOUS DISEASES.

The pallor and short breath peculiar to Bright's disease, point to a retrogressive metamorphosis, possibly to a necrosis of blood corpuscles. This would of course, reduce the amount of hæmaglobin. Which would not serve the purposes of hæmoglobin in a free state, would act as a foreign body in the system, and which would, unless eliminated, act inimically to the integrity of life.

We know already that a reduction of hæmoglobin means also a reduction of oxygen, and it is easy to understand and explain the dispnoea invariably present in this disease.

There are other diseases in which we find the red corpuscles of the blood greatly reduced. In chlorosis this reduction, according to Pryer, Simeron and Sabatin, often reaches down to five, and even four, per cent.; in leucæmia to six per cent.

The same authorities found the quantity of red corpuscles, (consequently, of hæmoglobin) very low in scirrhosis of the liver, and also in pyæmia. I have observed such diminution, also, in scarletina.

The "Centralblatt für die Medicinsche Wissenschaften," 1872, No. 22, mentions cases in which, in cancerous disease, the quantity of hæmoglobin was twice as much as normal.

Changes in the relative healthy proportion of hæmoglobin are also found in phthisis, pernicious anæmia, typhoid and other fevers, in erysipelas, purpurea hæmorrhagica and other diseases.

There is a field where more strict investigation is required, and a rich harvest awaits diligent microscopic, as well as spectroscopic research.

What is the effect of microbic life direct upon the blood? What is the deathly effect upon the blood life in cholera, yellow fever and other kindred diseases that have decimated and depopulated the earth again and again?

EXPLANATION OF PLATE.

Fig. I. Hæmoglobin crystals from blood of Man.
Fig. II. Venous-blood crystals from spleen of Man.
Fig. III.—(V. *a*) Hæmin, artificially produced.
Fig. IV. Hæmatoidin (after Virchow).
Fig. V. (*b*) Blood-crystals from Guinea pig.
Fig. VI. Blood crystals from Squirrel.
Fig. VII. Blood crystals from Fish.

PHOTO-MICROGRAPHY.

W. M. GRAY. WASHINGTON, D. C.

IT is the purpose of the present article to give the methods used, and the results obtained by the writer, in photo-micrography of sections of animal tissues. The subjects used were sections of tumors, pathological organs and normal histology.

Sections intended for photo-micrography must be exceedingly thin, and at the same time properly stained. To obtain the former quality, a mechanical microtome is necessary, as the sections should be evenly cut, and should range from $\frac{1}{4000}$ to the $\frac{1}{2000}$ of an inch in thickness, the object being to have as nearly as possible a single layer of cells, and at the same time, still preserve the general outlines of the structure of the tissue. Of the imbedding methods for obtaining the proper sections, paraffine used by the interstitial process, is preferable, as it allows of such evenness and thinness in cutting. Celloidin may be used in some cases, but does not give such satisfactory results, for the reason, it is not always possible to make as thin sections.

In staining tissues for photo-micrography, two objects are desired, intensity and differentiation. Of the innumerable staining agents, those most suitable, and easiest applied, are carmine, hæmatoxylon, and a few of the aniline dyes. Of all the carmines, borax carmine, if used correctly, invariably gives the most perfect results. In using this dye, it is always better to overstain, and and bleach with a strong acid solution; HCl. 10 per cent. in alcohol 70 per cent.; the bleaching must be carried to the point where the nuclei appear sharp and distinct, and yet the protoplasm be not entirely discolored, this result may be easily gained by a little practice.

Hæmatoxylon ranks second as a stain for photo-micrography. It has the disadvantage of being nearly useless for the wet-plate process, yet it will answer as well as carmine for certain dry-plate methods. While the aniline dyes are more applicable to the staining of bacteria, yet good results may be obtained with sections, especially by the use of Bismarck Brown; this is the ideal stain for the we-tplate process, but unfortunately does not answer perfectly for photographing with high magnifying powers; the reason for this is, that while it is seemingly a perfect nuclear stain, yet the protoplasm retains enough of the color to obscure the definition, or more properly, is rendered nearly as non-actinic as the nucleus.

For low powers, where a geographical picture of a tissue is wanted, it leaves nothing to be desired, giving a perfect black and white negative.

Of the different illuminating methods for photo-micrography sunlight is preferable; where it is not possible for the operator to obtain a heliostadt, a good sized mirror, swung on a double axis and regulated by hand will fill all the requirements; as the exposure by sunlight is of so short a duration, it is quite easy to keep the light centered. In using sunlight as the illuminant, the light should be passed through a cell of saturated solution of alum, in order to extract the heat rays; otherwise, unless great care be taken, there is danger of melting the cement of the substage condenser or objective.

The photographic process employed, will determine the color of the screen to be placed between the source of light and the microscope, to render the light monochromatic. For the wet-plate process, a cell of ammonia sulphate of copper is used. In dry-plate work, for the orthochromatic process, instead of the ammonia sulphate of copper cell, one of a saturated aqueous solution of picric acid is used; this gives a yellowish orange light, which, with the orthochromatic dry places, it is possible to get successful pictures of tissues stained by any dye, although the reds and blues give the best results.

After arranging light, color-screen, microscope etc., in their proper order, before successful work can be accomplished it will be found necessary to have a proper focusing-screen to the camera. For high powers and fine focusing, the finest ground glass will be too coarse, the best substitute will be a gelatine plate. To prepare this focusing-screen, place a gelatine plate in a holder, and underexpose, then develop, fix and wash thoroughly, as for an ordinary exposure; the plate thus developed will show a slight milkiness, and yet be perfectly transparent; place this plate in the camera with the film surface toward the microscope. This will give a focusing surface, on which the finest cell can be distinctly seen, and on which a focusing glass may be used to advantage.

For cheapness and at the same time excellent results, the wet process must certainly rank foremost, though the knowledge necessary will always be a bar to its general use by amateurs.

Of the different dry plates in use, the ordinary dry plate will be found a snare and a delusion for photo-micrography, except, perhaps, for bacteria work. The orthochromatic and the isochromatic are the only dry plates which will insure results equal to or

better than those of the wet-plate process. As these plates are sensitive to both orange and ruby light, the dark room must be especially prepared for handling them; for this purpose the ordinary ruby glass of the dark room should be covered with one thickness of orange paper, and then by one of brown tissue paper; even in this light the plates should not be exposed for any length of time. The length of exposure for the orthochromatic plates varies, of course, with the amount of light and the objective used; roughly speaking, it may be said to range from one second to fifteen or twenty seconds. We have exposed a plate one second with a Tolles 4-inch objective, and found it not over-exposed, and with a Powell & Leland 1-25 hom. im. objective we have given as high as fifteen seconds exposure with perfect results. A little practice will soon enable the operator to determine the necessary amount of exposure for a certain quantity of light. It will be found best to make the mistake of a slight over-exposure than that of under-exposure, as the former is more easily corrected in the process of development by restraining.

Of the different developers, ferrous oxalate, pyro- and hydrochinon, the latter is the only one that will give uniformly perfect results in photo-micrography. Of three plates developed respectively in ferrous oxalate, pyro- and hydrochinon and exposed for the same length of time at the same object, that developed by the hydrochinon was the only one found to be perfect and at all approaching a wet plate in printing quality. Owing to the slowness of this developer a quality of great advantage for photo-micrography and lantern slides, the operator runs less risk of spoiling a good negative by over-development. The hydrochinon developer may be used over and over again, and this fact, viewed from an economical standpoint, is well worth considering.

The following is a formula for the hydrochinon developer to be highly recommended for photo-micrography and lantern slides:

No. 1.

* ℞	Soda Carbonate.....	400 grains.
	Water.....	8 oz.

No. 2.

	Hydrokinone.....	96 grains.
	Soda Sulphate.....	480 "
	Water.....	8 oz.

Developer No. 1, two drachms; No. 2, four drachms; water, two ounces. Add one or two drops of a ten per cent. solution of bromide of potassium.

* The Philadelphia Photographer, December 17, 1887.

If after using a number of times the developer precipitates, filter before reusing. In developing place the plate in a covered dish, and flow on enough of the solution to cover it. This may now be put aside for several minutes, while other work is being done, with no fear of over-development.

ARMY NATIONAL MUSEUM, WASHINGTON, D. C.

THIN SECTIONS.

C. H. STOWELL.

IT will be a fortunate day for all workers when they see the editorial in the May number of this journal on the proper thickness of microscopical sections.

The first question we used to hear asked about a microscope was, how much does it magnify? but now it is, what will it show?

Here is a great advance, surely. We do not care to have an object look large simply for the sake of seeing a large object. Workers have awakened to the fact that the enormous "Centennial" and "International" stands are not absolutely necessary for good resolution. They appear to have most value when exhibited to an astonished jury as a most wonderful instrument, "with which one can tell the blood of a woman from that of a man."

But it is to be feared we are not making advance on the question of section cutting. A recent writer says that all sections should be only as thick as a single layer of its elements; meaning, we should take it, that the thickness of any section should be no greater than the thickness of a single cell.

I have some sections of lung so thin they show scarcely anything at all; yet it is my opinion that they are far from being as thin as the 1-4000 of an inch.

Sections of skin cut in this way are of but little value; and thus we might go on, but our desire is to simply add our testimony to the list.

With the modern microtomes, it cannot be regarded as any great skill to cut these fancy sections; while it does take a fair amount of technical knowledge to properly interpret what is in the field.

The advance in this line will be, not the question "how thin is your section?" but rather "what will your section show?"

ANN ARBOR, MICH.

PROCEEDINGS OF SOCIETIES.

OHIO STATE MICROSCOPICAL SOCIETY.

THE Ohio State Microscopical Society held its regular monthly meeting Friday evening, April 27th, at the Mayor's office, in the City Hall, in Columbus, Ohio, and was one of the best meetings, both in interest and attendance, that we have had.

Committees for the reception and entertainment of the A. S. M. are being appointed as fast as possible, and the following have been announced: General Committee, Dr. A. M. Bleilie, chairman, Gen. John Beatty, Prof. H. Weber, Prof. W. R. Lazenby, Mr. H. Braun, Dr. J. B. Schneller, Prof. J. H. Detmers, Dr. O. Frankenburg, Maj. A. D. Rogers, Dr. F. O. Jacobs, Dr. L. M. Early and Prof. B. F. Thomas. Finance Committee, Gen. John Beatty, chairman, and Prof. Lazenby, Mr. Braun, Prof. Detmers and Dr. Frankenburg. Other committees will be appointed at an early date.

It has been decided to give a series of papers and talks for the benefit of beginners in practical microscopy, and in accordance with this object, Dr. A. M. Bleilie gave the society the benefit of his experience in hardening and preparing specimens for section cutting. This was followed by an exhibition of Bausch & Lomb microscopes and accessories, and an explanation of their qualities and uses by Mr. H. Drescher.

Among the visitors present was Dr. Theodore Wormley, Professor of Chemistry in the University of Pennsylvania. Dr. Wormley was formerly a resident of Columbus, and Professor of Chemistry in Starling Medical College. W. J.

THE ST. LOUIS CLUB OF MICROSCOPISTS.

THE first annual meeting of this society was held May 1, and elected the following officers for the ensuing year: President, H. M. Whelpley; vice-president, D. L. Haigh; secretary, Frank Davis; treasurer, Wm. Ilhardt; curator, J. C. Falk. A committee was appointed to purchase a suitable cabinet for the growing collection of slides.

A vote of thanks was tendered the St. Louis College of Pharmacy for courtesies extended the club.

"The Microscopal Examination of Honey" was the subject presented by J. C. Falk. He has examined numerous samples, and has

been able to distinguish the pollen grains in pure honey, while they are absent in artificial honey and only sparingly present in adulterated honey. The pollen grains vary considerably in size, but are easily distinguished with a 4-10 inch objective. The members of the club will examine the honey for sale in St. Louis, and report at the next meeting.

One of the Griffith Club microscopes was shown, and admired by all.

The next meeting occurs June 5.

ELEMENTARY DEPARTMENT.

A COURSE IN ANIMAL HISTOLOGY.

FRANK W. BROWN, M. D.

THIRD PAPER.

BLOOD.—As blood-cells are exceedingly delicate, great care should be taken in their examination. When removed from the circulation they quickly undergo various changes, even when no reagents are brought in contact with them. To study them satisfactorily requires that their preparation for examination should be rapidly performed and that the specimens should be frequently changed for fresh ones. Reagents, excepting those required to 'develop' certain structures of the cells, should be avoided. The most simple method is, of course, to place a drop of fresh blood on a slide, cover and examine. When this is done, however, little can be seen as the corpuscles will be found packed together, and in several layers. A neat method for avoiding this condition has been suggested by Prof. Stowell. It is as follows: the surface of a glass slide is gently breathed upon and a drop of fresh blood is brought in contact with the slightly moistened surface. One surface of the cover-glass is now breathed upon and immediately its edge is placed close to, just in contact with the edge of the drop of blood. With the aid of a needle, the cover is lowered away from the drop, not over it, until it touches the slide. The blood corpuscles will immediately flow between these moist glasses by capillary attraction until the surface beneath the cover-glass is nearly or entirely covered. Prepared in this way it will be found that there is but a single layer and that the corpuscles are not crowded together. Such a prepara-

tion will do admirably for a short study. When it begins to dry at the edges a new preparation should be made.*

On examination two kinds of cells are discovered, the red and white blood-corpuscles. An inexperienced observer will have some difficulty in finding the latter as the former are from three to twelve hundred times more numerous. They should be looked for in the open spaces. They are somewhat larger and granular, and, when slightly out of focus, glisten with a pearl-like color. The student should learn to distinguish at a glance the red from the white cells.

Red blood corpuscles. The red cells will be seen, when magnified about 400 diameters, to be round and disc-shaped. They show a tendency to adhere together, forming *rouleaux*—rolls of coin—suggesting the idea that they are sticky. Looking over the field a few of them will be found on edge, they will then be seen to be biconcave discs. This biconcavity of the cells gives them different appearances when examined on the flat and at different foci. When the focus is below the cell the center will appear light and the edge dark, when above, the center is dark and the edge bright. This latter view gives somewhat the appearance of a nucleus. The red corpuscles are only red in the mass; individually they are a yellowish color which is slightly greenish if the blood is venous. This color is due to hämaglobin, which is evenly diffused through the cell. A human red corpuscle is about $\frac{1}{3200}$ of an inch in diameter and about $\frac{1}{12000}$ of an inch in thickness. Many cells will be found somewhat larger and, especially in certain diseased conditions, very much smaller. Careful examination shows that the mammalian red corpuscle is perfectly homogeneous, possessing neither nucleus nor limiting membrane. Attempts have been made to demonstrate the presence of one or both of these, but so far without success. All of these attempts have called in the aid of reagents, many of them very powerful, a dangerous procedure with such delicate material. It may be mentioned in passing that the mammalian embryo contains nucleated red corpuscles, but these disappear during later fœtal life.

Effects of reagents on the red corpuscles. Water causes the corpuscles to swell up and assume a somewhat spherical form. Later the coloring matter is dissolved out and the cell becomes pale leaving only the stroma behind. Alcohol, chloroform, acetic acid and many other chemicals have a like effect on the hämaglobin. When treated with the normal salt solution as well as with solutions

* To obtain fresh human blood, twist a handkerchief around the finger until the end is congested. Then stab it lightly with a sharp needle. If well done no discomfort will be experienced and it can be repeated as often as necessary.

of many other salts, they shrink up and become crenated. This action is supposed to be due to the abstraction from the corpuscle of carbonic acid, for when this is restored to them, they resume their former shape. Alkalis dissolve them rapidly, leaving scarcely a trace behind. Tannic acid in a weak solution—about 3%—has the curious effect of concentrating the coloring matter into one corner of the cell. The student should apply various reagents and study the effects on the corpuscles.

Compare the red blood-cells of fishes, birds and reptiles with those of the mammalia. They will be found as a rule to be very much larger, elliptical, and possessing large nuclei. The nucleus causes a bulging of the cell making it biconvex at the middle. The cells do not adhere and are not so sensitive to reagents as the mammalian corpuscles.

White blood copuscles. Because of the color they are generally spoken of as leucocytes. As seen on the slide they are spherical, granular, pearlish-white bodies, somewhat larger than the mammalian red corpuscle and much smaller than the reptilian, having a diameter in all vertebrates of about $\frac{1}{2500}$ of an inch. They contain one or more nuclei which can be seen without the use of a reagent as a round clear-cut body. A drop of dilute acetic acid will serve to make them more prominent. In the circulation they do not have a spherical shape, as, possessing independent movement, they are continually changing their form. This movement is called amoeboid from its resemblance to the form-changes of the amœba. The methods for studying this movement will be considered in another chapter.

Effects of reagents on the leucocytes. Acids and water make them more transparent, develop the nuclei and finally dissolve them. Alkalis dissolve them quickly.

Blood-plates. Within the last few years another element has been found in the blood: they are small, colorless, ovoid bodies having a diameter of about $\frac{1}{12000}$ of inch, and in number as compared with the red corpuscles, about 1 to 25. When removed from the circulation they quickly disintegrate, and appear to have to do

with the formation of fibrin to produce clotting. To demonstrate them, mix a little blood with a 1% aqueous solution of osmic acid, cover quickly and examine. A trained eye and good lenses will discover them. They require further study.

Other elements in the blood. Besides the bodies above described other microscopical matter is occasionally found in the blood. Small fat granules and other food substance, may be discovered after eating. "Phantom" corpuscles (the skeletons of red corpuscles); small pieces of red or white cells, particles of foreign matter of various sorts; all these may be found but hardly need description.

RUDIMENTS OF PRACTICAL EMBRYOLOGY.*

W. P. MANTON.

STAINING.

§ 8. Embryos may be stained *in toto*, or after the sections have been placed on the slide. The former method will be found the simplest and most convenient for general practice. Either of the carmine solutions, or the hamatoxylin, may be used, but the borax carmine has given the best results in my hands. If it is desired to stain the embryo at once after hardening and placing in 70 per cent. alcohol, it must first be washed in water (if it is a picric acid specimen, but not if it has been hardened in chromic acid), and then placed in the carmine, where it should remain for several hours, according to the size of the embryo. It is then washed again in 70 per cent. alcohol made slightly sour by the addition of a drop or two of concentrated hydrochloric acid. Thus stained, the embryo may be preserved in 95 per cent. alcohol, ready for embedding at some future time.

INFILTRATING.†

§ 9. A. Before sections of the delicate embryo can be made, it must first be infiltrated and embedded in some material which will hold it firmly without injuring its tissues. For this purpose, paraffine has been found to be the best substance. The specimen is first placed in absolute alcohol for several hours, until it is thoroughly dehydrated, and then in a vial of chloroform where it may soak for some time longer. It is then transferred to a watch glass containing chloroform and fine shavings of hard and soft paraffine (1 to 5).

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*Copyrighted 1888.

†There are many methods given for infiltrating the embryo, but the following has been found satisfactory in the author's experience. Of course, the general technique once learned, no worker will pin his practice to one method alone. See Dr. Minot's article on this subject in the May MICROSCOPE.

The watch glass must now be carefully heated, either in what chemists call a "double drying jacket" (which is similar to the incubator already described, except that it has no wood-work, and wire shelves replace the drawers), or over a water bath, until the paraffine is melted and the chloroform evaporated. This properly takes from 12 to 24 hours, and is done in order that all traces of alcohol and chloroform may be driven off, and the embryo become thoroughly permeated with the paraffine. The embryo is then arranged at one end of a paper cell which has previously been partly filled with melted paraffine and the latter allowed to cool, and covered with warm paraffine.

B. If it is desired to cut ribbon sections, the paraffine used should be that having the lowest melting point. When this is cold, it must be carefully cut away around the embryo, which is again embedded in a paraffine having a higher melting point. The reason for this will be explained under section cutting.

Should the specimen float out of place during the embedding process, it may be returned to any position desired by the point of a hot needle. All instruments used at this time that come in contact with the embryo should be kept warm by holding in the spirit-lamp flame; otherwise the specimen will adhere to them and perhaps become torn and ruined.

Air bubbles which frequently collect about the specimen should be displaced by a hot needle before the upper layer of paraffine has become hardened. Specimens embedded in this way may be kept almost indefinitely.

EDITORIAL.

MODERN METHODS OF EMBEDDING.

THE recent progress made in the study of histology, both animal and vegetable, is due principally to three factors, namely: improved methods of embedding, new stains with greater powers for differentiating tissue-elements, and more precise section cutters. To no one of these, it seems to us, should more credit be allowed, than to the methods of infiltration and embedding; and students of a decade ago who depended upon elder pith or amyloid liver for holding the ordinary histological or pathological specimen for cutting, or, where greater care seemed necessary, employed the gum-arabic solution, or the abominable wax and oil mixture, cannot but be struck

with the present elegant, and, we might say scientific, methods of attaining the same end.

It is true that Bunge had published his *egg-emulsion* method, modified by Calberla as long ago as 1876, but, however well adapted to certain tissues and objects it may be, it could never become of universal service. No wonder then, when Schiefferdecker announced, in 1882, his modification of Duvall's discovery of a new substance of general use as an embedding material, that this was hailed with delight by all biological investigators. But, although celloidine has now been before microscopists for fully six years, and articles on its use have frequently appeared in our scientific journals and text-books, there still seems to be a profound ignorance on the part of some as to its successful employment. Our experience, dating from the time of Schiefferdecker's first article on the subject, has taught us that for embedding tissues having a loose mesh, there is no material better than celloidine. The main points in its use are, a properly hardened object soaked for several hours in equal parts of ether and absolute alcohol, then transferred for twenty-four hours to a thin solution of celloidine, and afterwards placed for several hours in a molasses-thick solution of this material, when it may be embedded on a cork or left indefinitely in the fluid.

Various modes for the successful employment of paraffin are constantly coming to the front, but none will be found of greater service than the excellent method proposed by Dr. Minot in our last issue. This, as the writer says, is sifted from the great mass of literature on this subject, and contains the essence of the best forms.

But, according to certain investigators, the use of either celloidine or paraffin alone has disadvantages which are only overcome when the two materials are properly combined. Kultschizky (*Zeitsch. f. Wiss. Mikr.*), an advocate of this method, places the hardened object for some hours in equal parts of ether and alcohol, then in a solution of celloidine for twenty-four hours, then in erigeron oil, erigeron oil and paraffin heated to 40° C., and finally in melted paraffin. The time which the object must remain in the oil, the oil and paraffin and the melted paraffin, can be determined only by trial and a knowledge of the structure of object to be embedded. Sections are cut dry, as in the simple paraffin method.

Much has of late been written in regard to the advantages offered by vegetable wax as an embedding substance, but from Francotti's careful experiments we learn that this material is much inferior to paraffin for this purpose. This writer finds that the best results

with vegetable wax are obtained as follows (*Bull. Soc. Belg. de Micr.*): The object is placed in 94 per cent. alcohol and kept at 48° C. over a water-bath. When the required elevation of temperature is obtained, small pieces of the wax are added to the spirits until a mixture having the consistency of soft soap is obtained. This mass is then placed in a bulb having a straight cooler about three feet long, so that the alcohol, as it condenses, will fall back into the bulb. When saturation of the object is accomplished, it, with the mass, is removed to another vessel, the alcohol evaporated off, and the specimen cast in a card-board or metal box. The subsequent treatment of the sections is somewhat troublesome, and possesses no advantages over the other methods.

One of the latest substances for embedding is suggested by Krysinski (*Virchow's Archiv*). This is photoxylin, a kind of pyroxylin used by Russian photographers, and which Krysinski considers superior to celloidine on account of its keeping without deterioration, and remaining clear in solution or mass. Mr. George M. Beringer (*American Journal of Pharmacy*, May, 1888), who has experimented in the production of photoxylin, finds that the following formula gives the best results:

"Nitrous acid, 43° R ..... 3½ lb. av.
Sulphuric acid ..... 4½ lb. av.
Potassium nitrate, granular ..... 8 oz. av.
Wood pulp ..... 4 oz. av.

"The nitrous and sulphuric acids are mixed in an earthenware crock and allowed to stand until the temperature has fallen to 90° F., when the potassium nitrate is added and thoroughly incorporated with the acid mixture. The wood pulp is then immediately immersed in the mixture and allowed to remain for twelve hours. It is then removed from the acid and thoroughly washed."

The material thus obtained is quite soluble in equal parts of ether and absolute alcohol. For general work, K. recommends two solutions: a thin solution (½ to 1 per cent.), and a 5 per cent. The specimen is placed from strong alcohol into the thin solution, to remain from twelve to twenty-four hours, when it is transferred to the thicker solution. To fix the specimen before cutting, it is only necessary to place it on a cork. A film soon spreads over the mass, which is then submerged in 70 per cent. alcohol, and after two or three hours, is ready for sectioning. This material is not at present obtainable in this country, but as it bids fair to rival collodion in surgical practice, it will undoubtedly soon create a demand and production.

In the above remarks we have indicated a few of the modern methods of embedding objects for the microtome. If we consider that the condition of tissues pictured under the microscope depends wholly upon the methods by which such tissues have been previously handled, the very great importance of skillful manipulation and suitable material in this department of our technology (embedding) becomes at once apparent, and while methods of tinction and accurate section cutting are of exceeding moment, upon the previous hardening and embedding of the specimen depends whether we shall see shrunken and distorted elements, or tissues, comparatively, as they appear in life.

THE many friends of Mrs. Louisa Reed Stowell, the distinguished microscopist, and formerly associate editor of THE MICROSCOPE, will be glad to know that she is recuperating from her recent sudden and serious illness.

ACKNOWLEDGMENTS.—From Mrs. R. F. Bingham, Santa Barbara, Cal., Arachnoidiscus Ehrenbergii on algæ; from M. H. Alter, Los Angeles, Cal., Isthmia nervosa, and diatomaceous earth; from A. Cheseborough, specimens of guana; from Dr. W. F. Boggess, slide of hypertrophied pituitary body.

TECHNOLOGY.

A NOVEL METHOD FOR COLLECTING DIATOMS.

IN an interesting article in the *Bulletin of the Torrey Botanical Club*, Mr. C. Henry Kain discusses the "Diatoms of Atlantic City and Vicinity." Speaking of the bright brown patches of diatoms frequently seen covering the surface of mud, he recommends that they be collected in the following manner: Half fill a bottle with water. Touch one of these brown patches lightly with the tip of the finger, and the diatoms will adhere; then place the finger over the mouth of the bottle and shake. The diatoms are, of course, washed off and remain. By repeating this process again and again, the water finally becomes quite brown. By the time the collector reaches home the diatoms will have settled to the

bottom, and the water may be poured off and the diatoms cleaned. It is worth while to examine under the collecting lens every promising patch of brown mud, for very pure gatherings of quite different species may often be collected within a few feet of each other.

DOUBLE-STAINING OF NUCLEATED BLOOD CORPUSCLES.—Dr. W. M. Gray gives the following note in *The Microscopical Bulletin:*

"Spread a thin layer of blood on a clean slide and dry. Immerse slide in a beaker of alum carmine (Grenacher's formula) for five minutes; wash in clean water, and immerse in a beaker of a weak solution of sulph-indigotate of soda or potash (the solution should be of a dark blue color—not black-blue, as in a strong solution). After the slide has acquired a purplish hue, wash in water and dry. After drying, warm slightly and mount in balsam. The nuclei will be a beautiful red, and the protoplasm a greenish blue."

NEW STAIN FOR TUBERCLE BACILLI.—The London *Lancet* gives Prof. Lubimoff the credit of introducing a new stain, Borofucsin, for distinguishing the *B. tuberculosis* from all other bacilli in sputum or tissue, which by this method remain colorless:

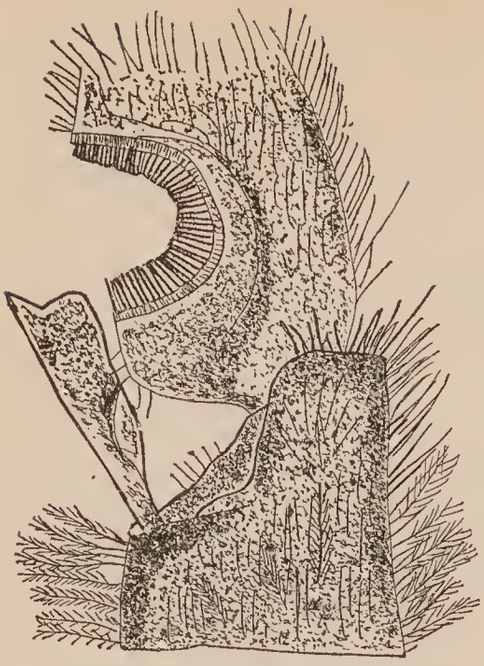
℞	Fuchsin	8 grains.
	Boric acid	8 "
	Alcohol, absolute	3¾ drachms.
	Distilled water	5 "

Spread the sputum on the cover-glass and heat in contact with the borofuchsin for one or two minutes. Wash in alcohol, and immerse in a saturated alcoholic solution of methylene blue for half a minute. Wash again in distilled water, dry, and examine in cedar oil or Canada balsam.

ABSTRACTS.

THE ANTENNÆ CLEANER OF HYMENOPTERA.—Prof. Cook, in an interesting communication in *The American Naturalist* on morphology of the legs of hymenopterous insects, thus describes the peculiar arrangement by means of which the busy bee and others of its kind are enabled to keep the antennæ free from soil and dust:

In the anterior or prothoracic legs of the honey-bee, he writes, we first notice at the base of the first tarsal joint and in the angle between it and the tibia a short, hollow semi-cylinder.



The concave surface of this cavity is smooth except at the outside margin, where there are from seventy-eight to ninety projecting hairs, which under the microscope remind one of the villi of the small intestines of mammals. These teeth, like hairs, projecting as a fringe, form a most delicate brush. The tibial spur is so modified as to resemble a very short-handled razor, the blade of which is for a wide space facing the tarsus, a most delicate membrane, and this blade forms a sort of lid to the cavity just described. When the leg is straightened this lid rarely reaches the cavity ; but when the first tarsus is flexed upon the tibia it serves as a cover to the cavity and really closes it. As the antennæ are not only the sensile tactile organs but also the organs of smell, it is of the highest importance that they be kept from the dust. But the very habits of most hymenopterous insects, visiting as they do, flowers laden with pollen, or digging in the mud and dust, tend to soil the antennæ. If a captive bee or wasp on the window-pane of our room have its antennæ quietly dusted with lime or flour, we will see it pass an anterior leg forward, draw an antennæ through the cleaner, and then pass the fore-legs, now foul with dust, between the brushes formed by the soft hairy inner faces of the basal tarsi of the inner legs. This will be repeated several times, when upon examination the antennæ will be found entirely freed from the troublesome dust.

MICRO-ORGANISMS.—In his work, "Die Mikro-organismen," Prof. M. C. Fluegge adopts the classification of De Bary and Frank, and passes in review all the pathogenic species of Hypodermii, Peronosporeæ, Pyrenamycetes and Mucorini, as well as those of Schizomycetes. In the case of *Aspergillus fumigatus* and *glaucus*, he states that the spores, if injected in sufficient quantities into the veins of a rabbit or guinea-pig, rapidly cause death. If rabbits, pigeons or other small birds are placed in an atmosphere holding *Aspergillus* spores in suspension, the bronchials and kidneys become rapidly filled with the mycelial filaments, and the same is the case with *Erysiphe* and *Oidium*. With Grawitz the author identifies *Oidium lactis*, *Achorion Schœnleinii*, *Trichophyton tonsurans* and *Microsporon furfur* as forms of the same species.

The Schizomycetes are classified by Prof. Fluegge under four principal groups, viz.: (1), *Micrococcus* (including *Staphyloccus*, *Streptococcus*, *Diplococcus*, *Aseococcus* and *Sarcina*); (2), *Bacillus* (including *Bacterium*); (3), *Spirillum*, and (4), a group allied to Nostocaceæ, comprising *Leptothrix*, *Crenothrix* and *Beggiatoa*. Each of the first two groups is again divided into pathogenic and saprophytic forms. The phenomena connected with gelatin culture are dwelt on detail with each species. The author inclines to the view of Koch and Cohn with regard to the genetic distinction of the various forms, rather than to that of Zoph.—*Journal of the Royal Microscopical Society.*

NEWS AND NOTES.

DR. FRANK L. JAMES, the accomplished editor of the *St. Louis Medical and Surgical Journal*, and author of "Elementary Microscopical Technology," has accepted editorial charge of *The National Druggist.*

THE *Popular Science News*' Paris correspondent calls attention to a paper recently read before the Academy of Sciences by M. Galtier, which concludes by saying that the tubercle bacillus is one of the most refractory to destroying influences such as desiccation, putrefaction, freezing, etc., and that none of the methods of practical appliance are potent enough to destroy them in houses, bed-material, carpets, etc., when a tubercular patient has lived in them for some time.

IN A paper before the Physiological Society of Berlin, Prof. Kronecker and Fräulein Rink reported an investigation which demonstrated that in peptone solution two kinds of bacteria are developed in the presence of air; Bacillus restituens, which transformed the peptone into serous albumen, exactly in the same way as did the living mucous membrane of the stomach; and Bacillus virescens, which liquified the alimentary gelatin and imparted a deep blue coloring to all sterilized substrata when exposed to the air. This latter bacillus operated poisonously on the heart.—*Bot. Gazette.*

NETTER, as the result of a number of observations, came to the conclusion that the pneumococcus may be the cause of simple meningitis, without a previous pneumonia; and that it may be the occasion of cerebro-spinal meningitis.—*Med. and Surg. Reporter.*

BACILLUS OUR BANE.

O bogie-like baleful Bacillus,
  Untouched by our potions and pills,
You enter to conquer and kill us,
  The taint that brings terrible ills.
You lurk in the air and the water,
  The presage of peril and pain,
You stride on serene to our slaughter,
    Bacillus our bane!

You must have existed for ages,
  But ne'er in the past you appear
In mystical medical pages—
  When suddenly, lo! you are here.
Though climates be arctic or tropic,
  You come with disease in your train:
Seen surely on slide microscopic,
    Bacillus our bane!

"*De minimus non curat lex*" is
  A motto we've all heard before;
The tiny Bacillus that vexes
  No medical man can ignore.
The smallest of things in creation
  An eminence high may attain;
You pull down the head of a nation,
    Bacillus our bane!

Though some folks deny your existence,
  Though fierce physiologists fight,
With painful, unpleasing persistence,
  Professors bring new ones to light.
Each boasts of the one he detected,
  Its beauties will gladly explain;
Is our admiration expected,
    Bacillus our bane?

While knowledge is power, recognition
  Of such horrid atoms as these,
Each like a malific magician,
  Can scarce be expected to please.
Although we've endeavored to quiz it,
  It smiles vibrionic disdain;
But don't bother us with a visit,
    Bacillus our bane!

—*Punch.*

MR. F. DUBOIS contributes to *The Garner* an interesting "skit" on microscopy. The same journal contains a very readable article on eyes, by F. V. Theobald, F. E. S.

POPULAR SCIENCE NEWS gives this formula for the pencils manufactured by Faber, in Germany, for writing upon glass, porcelain or metals: Melt together spermaceti four, tallow three, and wax two parts; and add six parts of either red lead, white lead, or Prussian blue, according to the color desired. The mass is turned out in sticks, and is then ready for use.

DR. HENOECUE, of Paris, has invented a portable hæmatospectroscope, by means of which both qualitative and quantitative analysis of hæmaglobin and its derivatives can be made at the bedside. The instrument is applied to the thumb nail, where, with good light, the energy of the exchange going on between oxygen and the tissues can be seen. This new idea may prove of great practical importance in the study of the phenomena of nutrition.—*New York Medical Journal.*

FROM the *Scientific American* we learn that through the liberality of Mr. William Smith of Geneva, N. Y., a fully equipped astronomical observatory has been established at that place, with Prof. Wm. R. Brooks as director.

THE smallest flowering plant is the *Wolffia microscopica*, a member of the Lemnaceæ or duck-weed family.

No department of physical research is more fascinating to the biological investigator, or more transcendently important to the human race, than that one of comparatively recent development, the study of micro-organisms and of their agency in producing disease.—*Science.*

THE death of the Russian Zoologist, M. Bogdamow, aged 47, is announced as having occurred March 16th.

WE notice that the distinguished microscopist of Chicago, Hon. Marshall D. Ewell, is announced to give a special course on medical jurisprudence at Cornell University during the coming year.

For the extraction of sublimate from tissues Mayer employs tincture of iodine. The tincture is added in small quantities to the alcohol in which the objects are preserved, as often as the color fades.—*Am. Naturalist.*

BOOK REVIEWS.

THE ESSENTIALS OF MEDICAL CHEMISTRY AND URINALYSIS, by Sam. E. Woody, A. M., M. D., Professor of Chemistry and Public Hygiene, and Clinical Lecturer on Diseases of Children, in the Kentucky School of Medicine. Second edition. Louisville : John P. Morton & Co., 1888.

From the preface we learn that "the aim of the work is to present the *essential* facts of a course of lectures on Medical Chemistyr

and Urinalysis, so that the student need not wade through the more exhaustive text-books." By a few indolent students such an aim may be considered a good one, but to any person interested in the proper education of physicians it seems vicious. Such a condensation has a use as an adjunct to the more complete text-books, for class-room and laboratory reference, but it is rarely that an author offers one as a substitute.

The introduction is a short article on theoretical chemistry. Under inorganic chemistry are briefly presented the elementary facts of the chemistry of the elements and inorganic compounds. Twenty pages are devoted to organic chemistry. In this the author has entirely lost sight of the beautiful relation which exists between the various classes of organic compounds, and which makes their study easy and fascinating. Thus the organic acids are taken up in this order, acetic acid, benzoic acid, picric acid, carbolic acid (!) citric acid, formic acid, etc. Not a very logical arrangement. In this chapter also are found expressions so careless as to make much of the matter worse than useless. For example, the author says: "The alcohol radicals, a homologous series of *univalent* basylous radicals." What would he call the trivalent radical, glyceryl, $C_3 H_5$? Or the hexivalent radical, mannityl, $C_6 H_8$? Again, he defines the simple ethers as "the results of dehydrating two molecules of alcohol by means of sulphuric acid." As a definition of the compound ethers, he says they "are made by treating the appropriate alcohol with the appropriate acid." In a work on one of the exact sciences such expressions are inexcusable. In the chapter on the urine are given some of the main facts very well presented. Taken as a whole the book cannot be commended.

THE MODERN TREATMENT OF PLEURISY AND PNEUMONIA, by G. M. Garland, M. D. Pp. 103. Paper, 25c. Geo. S. Davis, Detroit.

THE INFECTIOUS DISEASES, VOL. I, by Karl Liebermeister. Pp. 141. Paper, 25c. Geo. S. Davis, Detroit.

These two little books, forming Nos. 7 and 8 of the Physician's Leisure Library, are fully up to the standard of the former numbers.

Dr. Garland gives, in a simple and concise manner, the most approved modern treatments of pleurisy and pneumonia. The average text-books are very deficient on these points, so far as recent work is concerned, and the reading of this little book will prove of much value.

Dr. E. P. Hurd is the translator of Liebermeister's book, and has done his work in a satisfactory manner. Believers in the bacterial origin of disease will find in Liebermeister a strong advocate of their cause. Both books are in the best style of the publisher.

ILLUSTRATED PRICE-LIST OF INSTRUMENTS FOR ELECTRICAL MEASUREMENT, ETC. A. K. Eaton, 191 Fulton St., N. Y.

A CONTRIBUTION TO THE STUDY OF THE MANGO WEEVIL, by W. J. Simmons, Esq., Calcutta. Reprint.

ON THE FRESH WATER INFUSORIA OF THE WELLINGTON DISTRICT, by W. H. Maskell, F. R. M. S., Wellington, N. Z. Two Reprint.

The above contributions to microscopical science indicate the excellent and valuable work which is being done in such remote countries as India and New Zealand. In both Calcutta and Wellington the microscopical societies are in a flourishing condition, and as we have already stated, are exerting a positive influence on the advancement of science in those countries.

The Puzzler is a new monthly, published by N. D. C. Hodges of New York, and devoted to the riddles of the Sphinx. It is unique in its way, enters a field until now unoccupied, and will be a welcome source of amusement and recreation to many during leisure moments.

PHENOLOGICAL STATIONS, by Alexander Ramsey, F. G. S. Garner Reprints.

THE EXTRACTION OF CATARACT AS INFLUENCED BY MYCOLOGICAL DEVELOPMENT, by A. E. Prince, M. D. Reprints.

THE PULLEY METHOD OF ADVANCING THE RECTUS, by A. E. Prince. Reprint.

AN ANTISEPTIC ATMOSPHERE.

CLUB FOOT.

PALATOPLASTY, by David Prince, M. D. Reprint.

TAX REFORM. Speech of Hon. Alfred H. Colquitt, of Georgia, in the United States Senate, March 12, 1888.

OUR ICE SUPPLY AND ITS DANGERS, by T. Mitchell Prudden, M. D. Reprint.

TRANSACTIONS OF MICHIGAN STATE BOARD OF HEALTH.

CORRESPONDENCE AND QUERIES.

W. L. A., Greenbush, N. Y.—Dr. Frank L. James described an excellent method of preparing urinary deposits in the St. Louis *Medical and Surgical Journal.* He epitomizes the method as follows: "The urine is allowed to settle in the usual manner and the supernatant clear fluid drawn off with a pipette. Distilled water is poured over the sediment, and after gentle agitation again allowed to settle. I sometimes repeat this process two or even three times. The last time I add a solution of osmic acid (1:100), about five minims to the half-ounce of fluid. In a few hours, with exposure to the light, the fluid turns inky black, and, on decanting, the epithelia, casts, etc. will be found stained a uniform bluish-gray. I then again cover with water and add a few minims of an aqueous (or alcoholic) solution of eosin. Let settle, draw off the water and replace with pure glycerin, and mount in the usual way. Such mounts will be permanent." Though there are other methods, the above given will prove most satisfactory.

EXCHANGES.

This department is for the benefit of SUBSCRIBERS *who have microscopical apparatus, material or books which they wish to exchange, and such wants will be* INSERTED FREE OF CHARGE. *The number of insertions given will depend upon the number of exchanges received each month. Subscribers will please notify us when articles have been exchanged or sold. Dealers are referred to our advertising department.*

WANTED—"Synopsis of North American Lichens," Tuckerman, and "Manual of the Mosses of the United States," Lesquereux & James. Will give fine slides or cash.
H. M. RICHARDS, 27 Ellery St., Cambridge, Mass.

FOR EXCHANGE—Good mounts of double injected kidney, Trichina Spiralis, Fallopian tube of kitten and a variety of tumors for good pathological or histological mounts, or for sale at 15 cents each. C. B. CLAPP, Danville, Ill.

FOR SALE—A Hildebrand Microtome, with knife. Price, $10. Address
W. J. NEW, No. 32 W. Noble St., Columbus, Ohio.

FOR SALE AT A BARGAIN—A collection of histological slides.
ARTHUR LOEWY, Oak Park, Cook Co., Ill.

FOR SALE—A Tolles 1-12 in. objective, a very fine lense and practically new, having been used only a few times. Cost $100, and will be sold for $60.
Address, E. K. BAXTER, Sharon, Vt.

SLIDES FOR EXCHANGE—Peristomes of Moss and Diatoms, for miscellaneous mounts and material. Address, Dr. E. D. BONDURANT, Tuskaloosa, Ala.

FOR SALE OR EXCHANGE—Vols. I to VI inclusive, of Phin's American Journal of Microscopy, vols. I and II bound, price, $4.00. Wanted Langley's The New Astronomy or Slides. E. CROCKER, Berea, Cuyahoga Co , Ohio.

SPECIMENS OF UTAH ROCKS AND MINERALS; also natural deposits from the mineral lakes and springs of Utah and Idaho, in exchange for good mounts.
Address, PROF. J. E. TALMAGE, P. O. Box 75, Provo City, Utah.

WILL EXCHANGE COLE'S STUDIES IN PATHOLOGICAL HISTOLOGY, Vol. III, for Cole's Studies in Animal Histology. Vol. II or IV. I offer full text and 12 slides and desire the same in exchange.
A. B. AUBERT, Maine State College, Orono, Maine.

FOR SALE—A Bausch & Lomb "Professional" Microscope, complete, nearly new. Catalogue No. 561; list price, $185.00. Best cash offer wanted—— ——?
J. H. SMITH, M. D., 909 S. Charles St., Baltimore, Md.

FOR EXCHANGE—Synopsis of the Diatoms of Belgium, by Dr. Van Henrck, 132 plates unbound. Will sell, or exchange for an Abbe Condenser, or a good laboratory microtome and pay difference in cost. F. J. SCHAUFELBERGER, M. D., Hastings, Neb.

FOR SALE—Slide of Bacillus Tuberculosis (from Sputum) single and double-stained.
Address, WM. B. CANFIELD, M. D., 1010 N. Charles St., Baltimore, Md.

WANTED TO PURCHASE—Second-hand copies in good condition of Rev. Wm. Smith's "British Diatoms," and "New Greville Plates of Diatoms."
JAMES B. SHEARER, Bay City, Mich.

FOR SALE—A physician's microscope, manufactured by Bausch & Lomb; 2 eye-pieces; 2 objectives, 3-4 and 1-5; micrometer and camera lucida. For further particulars address A. W. ALLEN, 410 Grand River Ave., Detroit, Mich.

FOR EXCHANGE—Diatomaceous earth from the plateau of Thibet (12,000 feet) varieties localities; also material and slides from localities in Scottish Highlands. Wanted, slides of American Diatoms, Insects and Botany.
W. D. STEWART, 2 Gilmore Terrace, Edinburgh, Scotland.

FOR EXCHANGE—Injected cysts of Trichina Spiralis.
GILMAN DREW, Iowa City, Iowa.

WANTED—Parasites and books on Parasites and other micro-subjects; will give Anatomical, Pathological, Botanical, Microfungi, Zoophytes, Polycistina, Foraminifera, Parasites, and other slides in return. Shall be glad to open an exchange at any time with micro-correspondents for any of the above subjects.
FRED. LEE-CARTER, Gosforth, near Newcastle on Lyne, England.

FOR SALE—A Bausch & Lomb Model Microscope, with 1 in. and ¼ in. objectives.
W. H. OSBORNE, Chardon, O.

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VOL. VIII. DETROIT, JULY, 1888. No. 7

ORIGINAL COMMUNICATIONS.

THE GONOCOCCUS.[1]

WILLIAM BUCKINGHAM CANFIELD, A. M., M. D.

Lecturer on Normal Histology, University of Maryland, Baltimore.

UNLIKE the bacillus tuberculosis, the gonococcus has never made that impression on the medical mind that it should, and this is probably because the means of detecting it are not so certain as in the case of the former, and also because the diagnosis of a gonorrhœa does not so much depend upon an examination of the products of a urethral inflammation as the diagnosis of pulmonary consumption depends on an examination of the sputa. In medico-legal circles the gonococcus has demanded some attention, and it has undoubtedly been of use in some cases of interest. Although several investigators had suspected its presence as a cause of gonorrhœa, no one had done such exact work to detect it as Neisser,[2] of Breslau. In 1879 he made a communication to the "Centralblatt f. d. med. Wissenschaften," in which he described what he has named the "gonococcus," or specific micrococcus of gonorrhœa.

Since this time many others have confirmed his work. In 35

[1] Read before the Baltimore Microscopical Society, April 16, 1888.

[2] A. Neisser: "Centralblatt f. d. med. Wissenschaft," 1879, No. 28.

cases of gonorrhœa, 7 cases of purulent ophthalmia neonatorum, 2 cases of blenorrhœal ophthalmia, he found the gonococcus. Weiss[1] found it in 32 cases of gonorrhœa. Bokai[2] made cultivations and inoculated successfully several students who volunteered for the cause of science. The following have also confirmed Neisser's discovery: Aufrecht,[3] Ehrlich,[4] Gaffky, Rücker,[5] Brieger, Sadtler, Leber, Haab,[6] Hirschberg,[7] Krause,[7] Königstein,[8] Bockhart,[9] and others. The three last carried on successfully a series of experiments in inoculations upon eyes. Ogden described organisms resembling those found in pus taken from other sources not supposed to be gonorrhœal. This statement led Keyser[10] to investigate still further, and his work, done with the care of a painstaking student, is probably the most valuable contribution on this subject next to that of Neisser's. Keyser examined 67 cases of gonorrhœa and several cases of purulent ophthalmia. Three cases of what was supposed to be simple urethritis were examined and no gonococci were found.

The method of examination is very simple. A little of the pus is pressed between two cover glasses, which are then drawn apart. Then the glasses are allowed to dry, and are quickly passed through the Bunsen flame to coagulate the albumen and fix the pus. Then a few drops of the ordinary methylene blue or violet are allowed to cover the specimen for a few minutes and washed off. The specimen may at once be examined in water or glycerin, or it may be dried and mounted in balsam, which makes it more distinct. The gonococci are seen in pairs or fours, apparently in the pus cells, while the contour of the pus cells is seen to be very indistinct, due to the Abbé illuminator. Keyser says they are in the cell, and Neisser says they are on the cell. Of course, this is not easy to decide, but from my own experience in examining the gonococci and

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[1] Dr. F. Weiss: "La Micro du Pus Blenorrhagique." These de Nancy, 1880, and Gazette Hebdom., November 12th, 1880. Weiss: "Anales de Dermatol.," 1881.

[2] A. Bokai: "Ueber das Contagion der Acuter Blenorrhœæ." "Centralblatt," 1880, No. 74.

[3] R. Aufrecht: "Pathologische Mitt."

[4] Ehrlich: "Ueber Methylen blau und s. Klin. Bacterioskopische Verwendung," "Zeitschr. f. Klin. Med. 1," pg. 70, 1881.

[5] G. Ruecker: "Ueber Polyarthritis Gonorrhoica," Deutsche Med. Woch, 1880.

[6] O. Haab: "Kleinere Ophtalmologische Mitt.," Corres. f. Schweitzer Aertzte. O. Haab: "Der Mikrokokkus der Blenorrhœa Neonatorum." Festschrifft, Wiesbaden, 1881.

[7] Hirschberg and F. Krause: "Zur Pathologie der Anstechende Augenkrankheiten." Centralblatt f. pract. Augenheilkunde.

[8] Kœnigstein: "Zur Prophylaxis der Blen. Neonatorum." Vortrag gehalten in d. k. k. Gesellsch. d. Aerzte in Wien.

[9] Bockhart: "Beitrag zur Aetiologie und Pathologie des Harnrœhrestrippers." Sitzungs Ber. d. Wurz., Phys. und Med. Gesellschaft, September, 1882.

[10] "Is Gonorrhœa a Bacteria Disease?" by N. A. S. Keyser, Md. Med. Journal, February 15th, 1883. Langenbeck's "Arch. f. Chirurgie."

the other micro-organism, I am inclined to think they are on the outside of the pus cell.

The best way to confirm the discovery of a micro-organism is by cultivation and inoculation. This, of course, is not possible in every case of urethritis. Another way is by a process of staining which shall exclude every other micro-organism. Dr. Gabriel Roux,[1] of Paris, says that if the preparation be first stained according to Gram,[2] and then be examined, and then be decolorized with alcohol and examined again, the gonococci will be seen stained at the first examination, and will be unstained after decolorization with alcohol. Allen[3] and Wendt heartily confirm this. So far, I have not been doubtful in examining them myself, but as I have only looked for the gonococci in cases where gonorrhœa was undoubtedly present, my experience is of little value.

This discovery is of importance, in so far as it is one step nearer to our hope of classifying diseases in a scientific manner. Practically, it is of decided interest, as changing the mode of treatment, and thus cutting short the former length of the disease. It has also explained why some cases of apparently cured gonorrhœa break out afresh from taking stimulants after all signs and symptoms of the disease had disappeared.

1010 NORTH CHARLES ST., BALTIMORE.

MICROSCOPY FOR AMATEUR WORKERS.

H. M. WHELPLEY, PH. G.,

Professor of Microscopy in the St. Louis College of Pharmacy.

IN all civilized nations the physician is classified, by public opinion, among the leading members of the community in which he lives. The profession that he follows is one that accomplishes much for the general good of humanity and the advancement of collateral sciences.

When such facts are taken into consideration it is not surprising to find that doctors were among the first who appreciated the value of the microscope and made use of it in the interest of their profession. The exact period at which the microscope was introduced is not known, but it probably dates back less than three hundred years. We find that as early as 1608 the Italian philosopher Borelli made

[1] Le Concour's Medical, November 13th, 1886.

[2] Gram's method consists in staining first with methylene blue or violet, fixing the color with a solution of iodine in the iodide of potash, and then decolorizing with alcohol.

[3] "Journal of Cutaneous and Genito-Urinary Diseases," March, 1887.

use of the instrument in the study of animal histology. A few years later the Italian anatomist, Marcello Malpighi, viewed the circulation of the blood under the microscope and thus discovered the existence of the red blood corpuscles. From those dates up to the present time the instrument has been a faithful servant to the physician and a valuable aid in the progress of his science.

In view of such a condition of affairs, it is not startling to find some of the physicians of the present day looking upon microscopy and the application of a knowledge of the use of the microscope to medicine, as being nearly one and the same thing. The fact that such views are held is frequently impressed upon us when we converse on the subject with the average doctor who has a microscope and uses it (for a great many instruments in physicians' offices are only ornaments, or advertisements, or both). We well remember (for in this instance there was not much to remember) one of the courses of lessons that were taken from a physician. They consisted of a partial illustration of section cutting and mounting soft animal tissue in glycerine. Not a hint was given to lead us to infer that the microscope could be employed for any other purpose than that of examining flesh. The lessons were in strong contrast to some taken just before and others after this "special" course.

The increasing popularity of the microscope is bringing many amateurs into the field, and the question naturally arises: What shall such persons be taught? The instructions to which we have referred may answer very well for the student of medicine, who, as a busy medical practitioner, will not find time for any other than professional work; but in our opinion the amateur should be given an entirely different course of instruction. If the amateur is to give more attention to one subject than to another, we believe that vegetable histology and morphology presents one of the most suitable lines of work that he can adopt. Our reasons for holding such views may be summed up in the following points:

1. Moderate priced instruments, supplied with low powers, answer nearly every purpose.

2. The material for such work is easily obtained in almost endless variety.

3. Preparations for examination are comparatively easily made and mounted. They require no operations that may prove repulsive to the most sensitive.

4. The specimens are of general interest to the laity.

5. The subject presents an almost unlimited field for original research.

6. There is plenty of literature on the subject for reference.

The first one of the above points is an important one, as the majority of amateurs have simple stands and low powers. It is also much easier to work with low powers, as less time, patience and skill is required than high objectives with wide angles demand. The comparative cheapness of the outfit is also an item with many amateurs. A range of powers from 3 to 375 diameters can be obtained with two or three simple microscopes magnifying from 3 to 15 diameters and a good stand supplied with a 1-inch and a 2-inch ocular and a battery of objectives consisting of a three-inch, three-fourths-inch and one one-fourth inch. Such an outfit will enable a person to perform valuable and interesting work. The simplicity of vegetable structure and the magnitude of the cells render such a range of powers useful. The cells average from $\frac{1}{600}$ to $\frac{1}{400}$ of an inch in diameter, although there are also much larger as well as smaller cells. The cells in vegetable tissues are not only larger than those composing animal organisms, but in the former tissue we have to deal mostly with the walls of large cells, while complex cell contents perplex the animal histologist.

The second point requires but little explanation, as every one knows how plentiful vegetable matter is, and any person who takes the trouble can easily discover the rich variety of structures formed by the different relative arrangement in the plant of the two principal kinds of tissue, the parenchymatous and the prorenchymatous. However, we were not long ago surprised by a microscopist (one of the animal histologists) who had just "discovered" that the stem of a plant has differentiation of structure and that a plant can be identified from the transverse section.

In explanation of the third point we call attention to the thousands of pollens, seeds and trichomes that require no preparation for examination. It is also much easier to make sections of pith, wood, bark and leaves than of animal tissue. Nor is there anything repulsive to the most fastidious about the work, while animal matter is frequently so, at least to those who work as amateurs.

The fourth point will be appreciated by the majority of amateurs, as they frequently derive much of their pleasure from the entertainment of friends.

The fifth point will soon become apparent to the person who devotes a few months to work with vegetable matter.

The sixth point can be verified by reference to numerous foreign publications and the following among the English ones devoted to microscopy:

Elements of Botany (E. S. Bastin), Principles of Pharmacognosy (F. A. Fluckiger and A. Tschirch, translated by F. B. Power), Organic Materia Medica (J. M. Maisch), Companion United States Pharmacopoeia (O. Oldberg and O. A. Wall), Micrographic Dictionary (J. W. Griffith and A. Henfry), Microscopist (J. H. Wythe), Microscope (J. Hogg), How to Work with the Microscope (L. S. Beale), Food and Food Adulterants (Commissioner of Agriculture), Microscopy for Beginners (A. C. Stokes), One Thousand Objects for the Microscope (M. C. Cooke), Microscopic Fungi (M. C. Cooke), Wonders of Plant Life (S. B. Herrick), Objects for the Microscope (L. L. Clarke), Collector's hand Book (J. Nave), National Dispensatory (A. Stillé and J. M. Maisch), Examinations of Drugs and Medicine (C. H. Peirce), Pharmaceutical Journals, Journal of Microscopy, Vegetable Histology (Penhallow), Text Book of Botany (Bessey), Text Book of Botany (Sachs), The Microscope in Vegetable Histology (Schachet) and numerous other works.

Some of the experiments and work in vegetable histology and physiology that seem the most suitable for the amateur who desires to entertain and at the same time instruct his friends, is a subject that want of space forces us to defer to another time.

MORPHO-BIOLOGICAL CHARACTERISTICS OF THE GERM OF THE SOUTHERN CATTLE PLAGUE.

FRANK K. BILLINGS.

(*Continued.*)

THE reader need not look upon these corrections as contradictions between former statements, but rather as the result of more extended and exact and scientific observation. These objects being so exceedingly minute, it takes some time to educate the eye so that one can perceive every phrase of development. There are days when one cannot study them continuously at all. The best way to study hanging-drop cultures, when one desires to spend several hours over them, is to first make some cover-glass specimens of the same material or take any other slides of an object of the same size and form, and observe such for about half an hour, thus preparing the eye to see what you want to see in the living, developing organism. Unless this is done, some very essential points will be surely missed and some preventable errors fallen into. With anything less than a power of 800 diameters, no one should attempt to study these organisms, and then only when aided by the best of Abbè condensers and oil-immersion lenses.

We left our studies with the mature object proliferated into its first distinct stage of vegetative differentiation. We have two coccoid objects before us. That is, two round objects, their diameters being the same in any direction. If colored, they color throughout; that is, diffusely.

Were these objects to remain in this condition they would be indeed *Micrococci;* they do not, however. They almost immediately begin to increase in a longitudinal direction, but in this condition they still stain diffusely.

In my first description of the swine-plague germ I said *that the next biological phenomenon was the appearance of a delicate white line separating this ovoid object into two halves.* The above, while not exactly an erroneous description, is certainly anticipated by another phenomenon in the evolutional development of this coccoid, diffusely-coloring object into the mature form of any of this class of germs. *That this white, non-coloring substance is a secretion of the two pole or coccoid ends of these "belted" germs is beyond all question, as well as that it has a different chemical composition.*

These two facts, when taken together with the previously stated one, *that the white substance almost, if not instantly, disappears from view the moment both of the coccoid pole-ends have become shed off*, segmented, leads directly to the following hypothesis :

May not this white substance constitute, in part at least, the ptomaine, or essential poisonous, pathogenetic principle, in connection with these "belted" septicæmic germs ; and may not this process of the immediate dissolution of this white substance be the means by which the ptomaine gets into solution and then permeates the fluid cultivating media and the blood? Or, is this substance fluid and by the separation of the ends does it thus escape?

To my mind, these suppositions are worthy of consideration. The fact that we can find no evidence of the development of permanent spores by these germs and that this white substance is a secretion of the pole-ends, goes largely to support these hypotheses.

The phenomenon above spoken of, as anticipating the formation of the segmenting white line which separates the two darker portions of these organisms, is *that this white substance first appears in the center of the body of the dense, dark, ovoid object as the minutest of white specks, which gradually increases in size and quantity and extends across the entire object*—the white line—*being at first broader in the middle but gradually widening until it completely*

and clearly separates the two pole (coccoid) ends, and the mature object is again presented to our view, Fig. 6.*

We have thus described the normal, or general, cycle of development of the micro-etiological organisms of the *American, English and German Swine Plagues, the American Southern-Cattle Plague, Hen Cholera, the German Wild-Seuche* (of deer, swine and cattle), and *Rabbit Septicæmia*, all of which diseases are caused by a member of this class of "belted" germs and should be classed as extra-organismal, local, or land septicæmiæ. It seems to me that the germ of Yellow Fever, as well as the disease itself, should also come into this group. I am sorry to say, that, notwithstanding the result claimed by Freire, that I am unable to find a single exact and detailed description of the germ with which he works and which should, therefore, be the etiological moment in the Yellow Fever if there is any trustworthiness in Freire's statements.

PROCEEDINGS OF SOCIETIES.

THE MICROSCOPICAL SECTION OF THE WELLINGTON PHILOSOPHICAL SOCIETY.

THE Wellington Philosophical Society is one of the local societies affiliated to the New Zealand Institute. There are seven of these societies located in the chief towns of New Zealand, and the results of the work of each appear in the Annual Volume of Transactions of the New Zealand Institute.

In Wellington there is a Microscopical Section of the Society, holding fortnightly meetings in the winter. Each member is at liberty to pursue privately any branch of scientific work that suits him, but the Section as a whole, with a view to the preparation of a combined paper, prosecutes some special line of study.

The members would be glad to exchange material with any one who would do the same. The principal objects desired are Algæ (Desmidies and Diatoms), Zoological (Honcopterous Insects).

The first meeting of the Section this season was held on the 26th of March in the museum lecture room. After some discussion it was resolved that the subject for work should be a continuation of that of last season's, namely: the collection, examination and description of the flagellate, ciliate and tentaculiferous Infusoria of New Zealand.

* See April MICROSCOPE.

The President, Mr. W. M. Maskell, announced that he was preparing a paper on several new desmides of New Zealand.

Mr. A. Brandon presented the Section with a very useful dissecting microscope, and also exhibited some interesting mounts of a poisonous spider of New Zealand, the Katipo.

Mr. W. F. Barrand showed several slides of new species of diatoms from the Oamaru deposit.

Mr. T. M. Kirk showed one of Moller's beautiful slides of 500 diatoms, lent by the Hon. W. B. D. Maulett.

PRELIMINARY PROGRAMME OF THE A. S. M. MEETING. 1888.

COLUMBUS, O. June 22, 1888.

THE general programme of the Annual Meeting of the A. S. M., in this city, August 14–17, will be as follows:

Tuesday, August 14, 10 o'clock A. M., regular business; 2 P. M., regular business; 8 P. M., address of welcome by Governor Foraker; also one by Mayor Bruck, and President's annual address. Wednesday, 10 o'clock A. M., regular business; 2 P. M., session at the Ohio State University; address of welcome by President Scott, O. S. U., illustrated lectures by Prof. Lazenby and others; evening, reception at the Park Hotel. Thursday morning, regular business; 2 P. M., working session; evening, soiree. Friday morning, unfinished business, election of officers, etc.; Friday afternoon, excursion to Newark, Ohio.

W. J.

IRON CITY (PITTSBURGH) MICROSCOPICAL SOCIETY.

THE Society recently held its sixth annual microscopical exhibit. Fifty-three microscopes, with two objects for each, were displayed. The programme was good evidence of the prosperity of this organization.

ELEMENTARY DEPARTMENT.

A COURSE IN ANIMAL HISTOLOGY.

FRANK W. BROWN, M. D.

THIRD PAPER.

(*Concluded.*)

BLOOD—STUDY OF CIRCULATION.—Take a piece of stiff cardboard a little longer and broader than a small frog. Near one end make a hole to fit over the diaphragm of the microscope. Take a young frog, wrap it up in a damp cloth, or stun or pith it

in order to keep it quiet, and with pins stretch out and fasten the hind foot so that the web will be spanned tightly over the opening. Fasten the whole to the stage with clips, and examine with a low power. If the web be moistened with glycerin, the study of the circulation can go on for some time. A little search will show a number of vessels with the blood rushing through them. Select a small vessel where the blood is moving slowly, and the corpuscles can be easily made out. The red cells, more numerous and larger than the white, will be seen massed together in the center of the vessel, whilst the white cells, moving more slowly, cling to the sides. The red cells are seen to be very elastic, as they double and twist in going around angles in their course. Occasionally a red cell will block up a channel, causing a temporary stasis. When such a place is found, opportunity is given to study the amœboid movement of the white cells. Using a rather high power, the cell will be seen to send out and withdraw little processes, and, even though the blood current is stopped, to move along the vessel.

AMŒBOID MOVEMENTS.—If the student does not succeed in finding a suitable spot in the frog's web for the study of this amœboid movement, he will have no difficulty in doing so in a drop of blood placed on a warm slide. The slide should be kept warm and moist. A warm stage can be made as follows: Take a strip of copper the size of a glass slide, and make a diaphragm opening in the center. Attach a long strip of copper to this—or the whole can be of one piece—sufficient to reach a distance away from the stage of the microscope. The flame of an alcohol lamp heating the end of this strip will, by conduction, heat the whole piece, together with the slide placed on it. A drop of blood being prepared for examination in the usual way, make a ring around the cover-glass with oil to prevent evaporation, place on the warm stage, apply the heat, and the leucocytes can be studied in their movements with higher powers and with greater ease than was the case in the frog's web.

BLOOD CRYSTALS.—Though a number of different crystals can be obtained from the blood, only one will be described here. Hæmin or Teichmann's crystals are small, rhombic plates of a brownish or brownish-red color. They are important, as the chemical reaction necessary to produce them is simple, and their presence is a valuable test for blood. They are made as follows: A drop of blood is dried and pulverized. To a small quantity of this blood placed on a slide, add treble the amount of sodium chloride. Mix intimately and apply a cover-glass with a hair interposed to keep it somewhat away from the slide. Now add two or three drops of glacial acetic acid, and

heat just the point of boiling. Examination will show large numbers of perfect crystals, which should be sought for in the more open spaces. In case of doubtful stains, this test is valuable to determine whether blood be present or not. If sufficient of the stain can be washed on to the slide to make a dark yellowish mixture with water, the test can be applied. Do not forget to dry the specimen before the test is applied as the presence of water interferes with the test.

PERMANENT PREPARATIONS OF BLOOD.—Beautiful specimens of blood can be prepared by properly staining and mounting. Amphibian blood is to be preferred, as the red cells are so large and contain such prominent nuclei. A large number of stains have been proposed, many of them being most excellent. Numerous tests of the various stains were made in the laboratory of this journal, and one called the Heidelberg method (originator's name not known) was found to be the most satisfactory. It is as follows:

Allow fresh blood to fall drop by drop into a solution of osmic acid (2 per cent. acid solution, one part ; 1 per cent. solution sodium chloride, two parts ; distilled water, one part.) The solution should be constantly stirred while the blood is dropping. Allow the blood and acid to stand over night, and then wash the acid away with distilled water. Add alcohol, then clove oil, in which the blood may be kept indefinitely. Before the alcohol is added, the nucleus of the corpuscle may be stained in alum-carmine, the blood afterwards being washed ; or the whole corpuscle may be stained in analine blue. The alum-carmine is to be preferred, as being more permanent. Mount in balsam. We have slides of salamander and dog's blood prepared in this way some years ago, which are as beautiful to-day as when first finished.

RUDIMENTS OF PRACTICAL EMBRYOLOGY.*

W. P. MANTON.

THE PAPER CELL.

§ 10. This may be made of stiff glazed paper, card-board or canceled postal card, and of any size. A convenient shape for a small embryo is one and a half inches long by three-fourths wide and half an inch deep. Having cut the card of the required size, begin by folding down each side of a width to give the cell the

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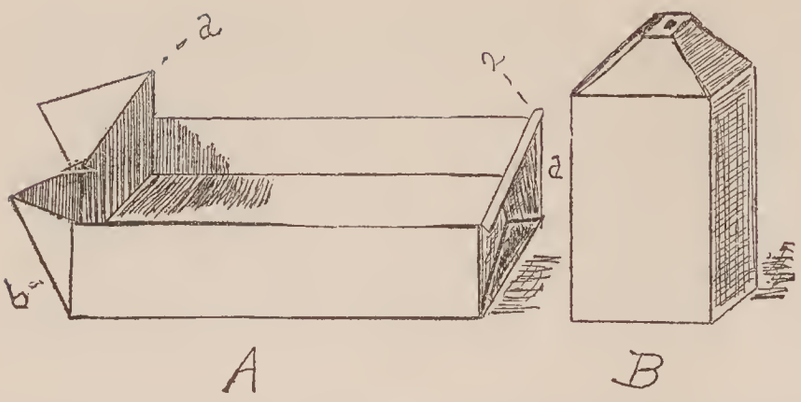


necessary thickness, and over them the ends a little wider than the sides. On opening the card a small square will be seen at each corner marked out by the folds. Now bring the *end* fold of one of these squares exactly against the *side* fold of the same square and draw the intermediate paper (*A*, *b*) between the thumb and finger, which divides each square into two triangles. Turn the triangle over the end of the cell and repeat on the other side. A complete end is thus formed to the cell. To hold the triangles in place and keep the end from unfolding, turn the top of the end paper, which projects a little above the level of the sides, over. (*A*, 2, *a*.) Prepare the other end of the cell in the same manner. It is necessary that the folds at the corners meet exactly, or the cell will be irregular in shape.

A very good cell-form may be made by bending rather thick pieces of lead, so that the two sides are at right angles to each other. For embryos, however, the paper cell is preferable.

SECTION IV.

SECTION CUTTING—PREPARATION OF SLIDES—MOUNTING.

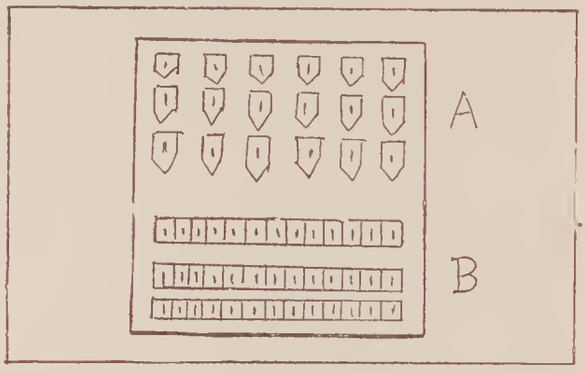
§ 11. The embryo, embedded as given in § 9, *A*, is ready for cutting. As the sections must be serial and laid upon the slide in regular order, so that the organs and parts may be studied with exactness, it is necessary that a sufficient number of glass slides be in readiness.* These must be perfectly clean and clear. Each slide in turn should be warmed over the spirit lamp flame, and when the moisture, which collects on the application of the heat, disappears, a glass rod dipped in the shellac solution (already mentioned) must be pushed over the slide in such a way as to leave behind it a thin film of the shellac. This may easiest be accomplished by running the rod across the glass, and then quickly drawing it over the length of the slide. It is not necessary, however, that over an inch of the surface should be covered by the shellac. If the film left turns opaque, it indicates that the glass was not hot enough, and in that condition is unfit for use. The film should be perfectly

* The size of the slide used is quite immaterial. Those which I have found most convenient for this purpose measure two inches by one and a fourth inch (Heidelberg form.)

smooth, free from waves, and so thin as to be only perceptible by the iridescent hue which it imparts to the glass. When ready to make sections, a slide should be selected and a thin coating of clove oil given it with a fine camel's-hair brush over that portion covered with the shellac film.

Care must be taken not to go over the same spot twice, as the oil dissolves the varnish.

For cutting embryos, a microtome is almost indispensable ; but fair sections may be made by one used to free-hand cutting with the razor. The labor is much greater, however, and the sections vary greatly in thickness. Before cutting, the paraffin should be trimmed down to within a few lines of the specimen, straight behind and triangular in front (*A*). Each consecutive section, as removed, must be laid on the prepared slide, beginning at the upper right hand corner and continuing in rows from right to left. Of course, no larger space must be occupied than the size of the cover-glass to be used.



The sections have a tendency to roll up as they are cut, but this may be prevented by holding the point of a teasing-needle or a camel's-hair brush just over the edge of the knife as it passes through the paraffin ; or, one of the numerous planishers, to be had of dealers in microscopical supplies, may be used.

When a sufficient number of sections have been placed, the slide should be carefully heated over the lamp-flame. This melts the paraffin, and dispels the clove oil, and permanently fixes the sections. By placing the slide on the edge the paraffin may be collected to one point. When the slide is cool a few drops of oil of turpentine should be poured over the sections to dissolve the remaining paraffin. The length of time during which the turpentine should cover the object depends upon the size of the latter and the amount of paraffin left in the tissues. The oil must then be run off and the glass carefully wiped clean up to the sections. A drop of Canada balsam, and the adjusting of the cover-glass completes the process.

If "ribbon" sections, as mentioned in § 9, B, are desired, the paraffin block must be trimmed accurately—the sides being parallel and the section-knife parallel to the side. If this is properly done, the edges of the sections will adhere, and a ribbon of almost any length

may be made. (*B.*) With the Thoma or Schanze microtomes, the tendency of the ribbon is to break during the process of raising the block. This is obviated by the automatic rocking, and other microtomes of this style.

EDITORIAL.

ARTIFICIAL LIGHT IN MICROSCOPICAL WORK.

THERE can be no dispute as to the superiority of good natural light over artificial light for general microscopical work; but, in addition to the unreliability of natural light, especially in the cities, where, indeed, it is rarely utilized, the fact that most microscopical work is done after dark, makes the subject of good artificial light one of the greatest importance to the microscopist.

Writers upon miscroscopical technology have not failed to recognize this, and they usually devote a short chapter to it, illustrated by numerous more or less complicated and costly lamps. In makers' catalogues, also, the same cuts are found and the lamps described. In these efforts to put before the microscopical public attractive apparatus, writers seem to have lost sight of the excellencies of the humble hand lamp. Beginners are thus led to purchase the expensive German student's lamp or some still more costly microscopical lamp. It can safely be asserted that for the general purposes of the working microscopist.a small hand lamp giving a broad, flat flame, such a lamp as can be bought anywhere for twenty-five or thirty cents, is superior to any of the expensive lamps made especially for the purpose, and we are convinced from our observation of the methods of many microscopists that this is not realized by many except the experts.

By the size of the flame and the distance of the lamp from the microscope, the intensity of the light can be readily adapted for any work, from the use of the lowest powers to the examination of histological and biological specimens with the highest immersion lenses. For bacteriological work with the $\frac{1}{12}$-inch or $\frac{1}{18}$-inch immersion lenses this light is unsurpassed In the examination of opaque objects this lamp is not so convenient, as it is necessary then to have the source of light at quite an elevation. It is very easy, however, to improvise a stand.

For the examination of all sections by central light it is best to place the lamp on the table directly in front of the micro-

scope at a distance regulated by the intensity of the light desired. In this position it leaves the way clear for the use of both hands in the manipulation of the slide and the sub-stage accessories. The heat and glare in the observer's eye may be readily overcome by the interposition of a little screen so arranged as to shade the face. Every microscopist can readily improvise such a screen. We have found a piece of card-board stuck on an ordinary desk-file, composed of an iron base and a vertical steel wire, to be very convenient for this purpose.

In the examination of diatoms and other objects by oblique illumination, the lamp may be placed at the right of the observer at a distance of about two and one-half feet from the microscope. Some experts, in testing objectives, blacken the chimney of the lamp and permit the light to pass through only a narrow slit.

To make perfect the illumination of an Abbé sub-stage condenser, is in all cases desirable, and in bacteriological examinations it is indispensable. With this condenser open, a cone of light having an angle of divergence of 120° is brought to a focus upon the object. Viewed with this intense light, the delicate contours of transparent objects, which are made visible by differences of refraction, are almost entirely lost, and the stained portions of the specimen, which would be, without such a condenser, more or less concealed by the outlines of the unstained portions, stand out in bold relief. This "isolation of the stained image," as Koch terms it, is of great value in histological study. An Abbé condenser should be a part of every histologist's microscope.

WE notice that physicians are beginning to avail themselves of the lantern to illustrate their papers on microscopical subjects. At the recent meeting of the American Medical Society, some excellent views of diseased tissues were shown, and we notice that Dr. A. G. Field, of Des Moines, recently entertained the Iowa State Medical Society by a stereoptican exhibition of the microbes mentioned in his paper before that body. This is an excellent method of impressing an audience with the idea that the author of an article knows what he is talking about. We expect to see the lantern commonly used for such purposes in the near future.

ACKNOWLEDGMENTS.—From Dr. W. M. Gray, Washington, D. C., we have received a number of photographs taken by the two processes, dry and wet, mentioned in his paper published last month.

While neither method can be criticised, it is apparent that the wet plate brings out the tissue-elements a little more clearly and sharply defined than the dry plates, and, although in its application the wet process is not quite so easy as the other, we are inclined, judging from Dr. Gray's photographs, to favor that. From Dr. A. G. Field, Des Moines, Ia., blue prints and photographs of urinary crystals, etc.

TECHNOLOGY.

METHOD OF INTENSIFYING THE RESOLVING POWER OF MICROSCOPE OBJECTIVES.

MR. G. D. HIRST describes a simple way of vastly improving the definition of objectives on close-lined test objects which has lately come under his notice. The credit of the discovery is due to Mr. Francis, of Sydney.

Take a valve of, say, *Amphipleura pellucida*, and having got the best results obtainable with mirror and condenser, let the analysing prism belonging to the polarizing apparatus be placed over the eye-piece, and rotated until it darkens the field, which it will do, though not to the same extent as when used with the polarizing prism. On carefully focusing the diatom, the lines will show themselves with an extraordinary increase of definition. Valves that, without the aid of the prism, only show a washy sort of resolution, will now show the lines as black as the bars of a gridiron.

On *P. angulatum* by central light, the result is also splendid. The same effect can also be obtained, though perhaps to a slightly inferior degree, with the objective, or, as it is placed in some stands, in a sliding box in the body of the microscope; in the latter case, as it cannot be rotated, the valve of *A. pellucida* should lie horizontally. For general purposes, it is better for the prism to fit over the eye-piece, as besides giving better definition in that position, with a diatom like *P. angulatum* and prism over the objective, the diffraction spectra would be cut out of the top and bottom of the back lens and the effect spoiled. Of course, in the case of *A. pellucida*, with the valve lying horizontally, it does not matter, as the dioptric ray and single spectrum are not cut off in any way by the prism or the box in which it is set. The prism has the effect of greatly diminishing the light of the dioptric beam; at the same time it scarcely touches that transmitted by the diffraction spectra.

The application of the prism will not, of course, make an objective resolve a test beyond the reach of its aperture; but it often happens that in the case of close-lined objects we can see the spectrum at the back of the objective when the lines cannot be seen in the object itself. It is then that the prism shows its power, as its use will at once bring out the lines with the greatest ease and sharpness.

Mr. E. M. Nelson found, while investigating the matter, that the diffraction spectrum of *A. pellucida* (illuminated by oblique beam from oil-imm. achromatic condenser, and with a water-imm. $\frac{1}{12}$), showed all the green, but no red. On examining the spectrum through the analysing prism without an eye-piece, he found that when the prism was in a line with the dioptric beam and the diffraction spectrum, the brightness of the green was intensified. On replacing the eye-piece, and viewing the image through the prism used above the eye-piece, as directed by Mr. Hirst, there could be no doubt that the transverse striae were much sharper and blacker than when viewed without the prism. The prism must, of course, be kept in a line with the dioptric beam and the diffraction spectra. Should the prism be turned across, even if it does not cut off the aperture, the definition will be impaired.

He next changed the water-imm. $\frac{1}{12}$ for a water-imm. $\frac{1}{16}$ of less angle, which would barely resolve the *A. pellucida*—that is to say, would only resolve it in patches, and not from end to end. On examining this with the prism, he found that the parts which were unresolved were still unresolved; but those parts which were resolved were intensified.

The image of *A. pellucida*, with an apochromatic $\frac{1}{8}$ ($\frac{1}{4}$ N. A.), my new eye-piece, and the prism is something very fine, such as I have never seen before.

He also tried the prism with several very subtle direct light tests, but cannot say that he found any improvement in the image. On the whole, he should think this class of objects would be seen better without the prism. Probably the efficacy of the prism, when used with a lined test, lies in the fact that it intensifies the diffraction spectra when it is placed in a certain direction to it.

—*Roy. Mic. Journal.*

POND DREDGING AND COLLECTING.—In reply to a correspondent's inquiry in *Hardwick's Science Gossip*, as to the use of nets in collecting rotifera, etc., Mr. Jno. Eyre writes: I should advise him not to use a net at all. The best appliance with which I am acquainted

is made by fastening a wide-mouthed glass bottle (such as a pomatum pot) to the end of a walking-stick, by means of a stout copper wire, which should be tightly whipped with strong thread and varnished. For more delicate work, or for use in ponds, etc., comparatively free from weeds, a large sized test-tube might be substituted for the bottle, and should be fastened to a short, thin length of bamboo, as follows: Take a six-inch length of caoutchouc tubing, and make a cross-cut three-quarters through, at about an inch from one end; then another at right angles to the first, along the other five inches ; the result is a short piece of tube with a five-inch slip of gutta-percha. The tube is slipped over the end of the rod, and the free end of the flap is pushed between the rod and the tubing, the test-tube placed in the loop so formed, and the slip drawn tight and fastened off.

MR. E. H. GRIFFITH suggests Berry's hard oil finish, with Sherwin & Williams' ivory drop black, for finishing slides *a la* Moeller.

CHLOROFORM AS A PRESERVATIVE OF URINE.—In the *Deutsche Medicin. Woch.*, Prof. Salkowski states that he has used chloroform to prevent specimens of urine from undergoing decomposition, a few drops being sufficient to retain its acid reaction for any length of time. Prof. Salkowski says, further, that an aqueous solution of chloroform is sufficient to prevent all those fermentations which are dependent upon the existence of micro-organisms, while it has no effect upon the action of unorganized soluble ferments, such as ptyalin and pepsin. Chloroform has a powerful destructive action upon bacteria present. An infusion of putrid meat is made sterile by it in a few hours. It has a like destructive action on the bacius anthracis and on the comma bacillus.—*Weekly Medical Review.*

PREPARING SECTIONS OF BUDS.—Take a small piece of twig—say linden—having a bud at its upper end; fix well in section-cutter, wet with alcohol, cut with a sharp knife into thin slices, keep flooding the knife with strong alcohol to keep the sections floating, and to keep them from pulling apart. Do not let a drop of water touch the section, or it will cause it to fall to pieces. Now place in alcohol faintly colored with iodine-green; let them remain for several hours, until the color disappears from the alcohol. Again put them into alcohol, this time colored a little more deeply with eosin in place of green. Let them remain there till they are

all pink. Then wash in two alcohols of 95 per cent., drop into clove oil for a few moments only, and mount in Canada balsam. They are thus very instructive.—*V. A. Latham in Scientific Inquirer.*

COLORING THE NUCLEI OF LIVING CELLS.—The most interesting fact brought out in Mr. D. H. Campbell's work at Tübingen is the fact that several anilin colors have the property of coloring the nucleus of many plant cells without killing them. That the living nucleus can be stained has been demonstrated by several observers in the case of animal cells, but, so far as he knows, it has not hitherto been observed in plant cells. Though the work is not yet completed, he thinks it will be interesting to give briefly some of the processes by which the results were obtained, and some of the objects employed.

The first color used was dahlia, a violet-purple pigment, by whose aid Lavalette had succeeded in coloring living spermatozoa and the nuclei of sperm-cells. The most favorable object so far found by the author is nucleus of the cells of stamen hairs of *Tradescantia. T. Virginica* was principally used, but other species gave equally good results. Hairs should be chosen from young buds, as these are perfectly colorless, not having developed the colored cell-sap of the older hairs. The sepels and petals are removed, and the stamens thus exposed are plunged into an aqueous solution of the dahlia. After an immersion of from half an hour to three or four hours, or even much longer, depending on the strength of the solution, it will be found that in many cases the nuclei are more or less deeply colored, and that the cell is not killed is evinced by the continuance of the protoplasmic streaming. It is quite surprising to see how deep the nucleus is often stained without killing the cell. A nucleus so colored appears perfectly normal, there being no distortion or change beyond the change in color. As yet he has not studied especially what parts of the nucleus are colored, but it appears to be the nucleolus and microsomes only, as in the case of cells that have first been killed and then stained according to the ordinary methods.

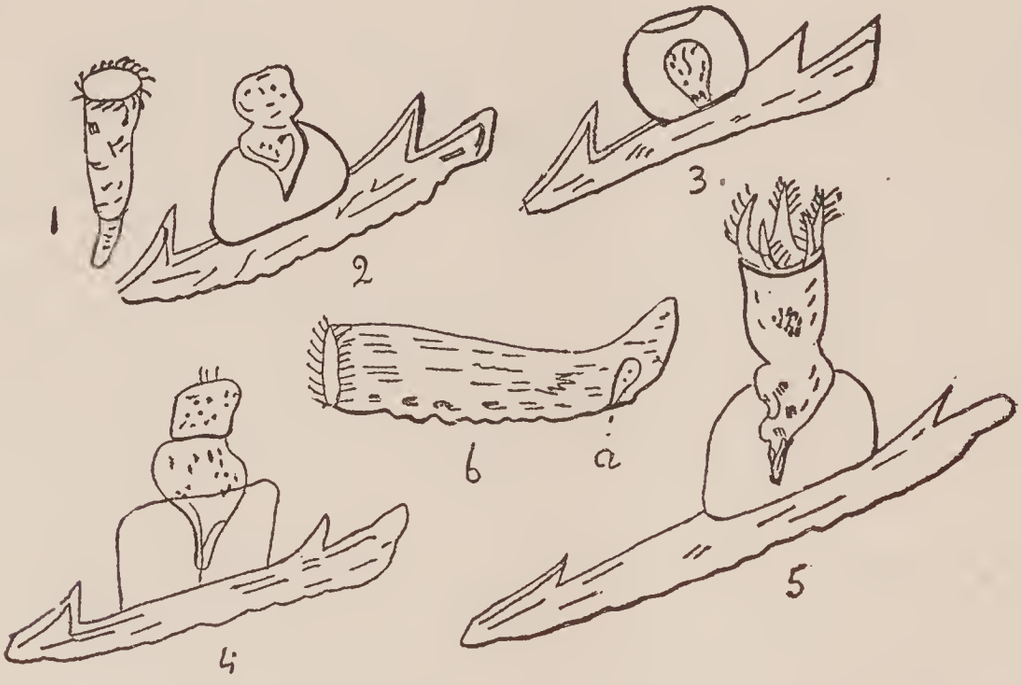
Among other objects that have given more or less satisfactory results were the hairs from the base of the perianth of *Lilium bulbiferum*, stamen hairs of *Aphodelus albus*, leaves of *Elodea Canadensis* and *Vallismeria sprialis*, root hairs of *Trianca Bogatensis*, *Cucurbita Pipo*, *Tradescantia zebrina*, spermatozoids of *Chara*, and a fern (probably Blechnum). In all cases cells were chosen in

which there was evident protoplasmic movement, in order that there might be a certain means of determining whether or not the cell was still living.

Similar and usually quite as good results were obtained with mauvein and methyl-violet, both colors closely resembling dahlia. Usually a 1 per cent. solution was made, and this diluted with from fifty to one thousand parts of water, according to circumstances. Some doubtful results were obtained with other colors, but too uncertain to warrant recording.—*Roy. Mic. Journal.*

ABSTRACTS.

STEPHANOCERAS EICHORNII.—W. H. Harris contributes to *Science Gossip*, under the title of a page of the life history of this rotifer, his observations on the production of the young. He finds that this rotifer is ovoviaporous,—the ovum, when excluded, remaining in contact with the parent. When the young first escape from the ova they are mere sack-like creatures with a fringe of cilia around the anterior end, (fig. 1,) the posterior end contracting to a rounded point.



In a case noted, the young escaped one hour after the ovum had been extruded. After swimming freely about for thirty minutes, it settled down, and in a few seconds attached itself permanently. It then elongated and contracted itself to its utmost extent, gave a few convulsive turns, and in three minutes from the time of settling, the first portion of its future dwelling place was distinctly visible (fig. 2. Harris suggests that the reason for the movements noted might be a

divesting of the rotifer of a very thin and hyaline pellicle, and sees no reason why this would clash with the theory that the adultt ube is a secretion, since it would assist the flow of the fluid in a proper direction for the purpose it has to serve. Following these movements the rotifer retreats within the cup-like tube, assumes the form of a puff-ball, and remains apparently quiescent for some time; hardly perceptible changes are, however, going on, (fig. 3.) Four hours later, the organism is visibly enlarged, the cilia have become arranged parallel to each other, and protrude like a small bush, (fig. 4.) These are afterwards absorbed, and an hour later partly developed arms are seen (fig. 5.) After this development goes on and is completed by the following morning. The development is not always the same in point of time in different individuals, one act being, perhaps, prolonged, while another is greatly shortened.

As to the length of time after birth when reproduction will take place, a series of observations gave the average as $6\frac{1}{3}$ days.

The largest number produced by one individual was five; the smallest three,—more frequently four completed the progeny. While the male of this rotifer has not been discovered, Harris found one individual with a pear-shaped cavity near the angle where the posterior portion rapidly narrows; and in this space were bodies in rapid motion, and which may have been spermatozoa. This creature did not settle down like the others, but led a wandering life; it increased but slightly in size, and its development was arrested at a very early age. It lived about thirty-six hours and was not seen to take any food.

Pathogenesis was seen to take place to the fourth generation; the last individuals containing ova, which did not develop, the individuals dying after a normal life, without issue. The allotted span of life is from 13 to 14 days.

THE DEVELOPMENT OF BONE.—Dr. W. X. Sudduth read before the International Medical Congress a paper on the above subject, presenting at the same time several sections of new bone under the microscope. He reviewed the various processes by which bone is developed, and stated his belief that another classification of the methods by which growth occurred, and suggested the word "interstitial" as having special reference to ossified products which came under the classes heretofore in general use, namely: intra-membranous, intra-cartilaginous, and sub-periosteal. There has been an attempt on the part of nature at the age of one or two

months to differentiate a periosteum by a condensation of the connective tissue into a membrane in the case of the maxella and bones of that class—that is, groups of osteoblasts are seen arranged together more or less regularly, but independent of the periosteum.

At first the specialized cells are found in a double layer, but later on they may be seen at the termini of the trabeculæ. As the osteoblasts build themselves into the wall of forming bone, new layers take their place. When each osteoblast, by secreting its calco-spherule, completes its life work as a bone builder, it becomes a bone cell. The osteoblast is undoubtedly derived from the corpuscles of the blood.

NOMENCLATURE OF PATHOGENIC ORGANISMS.—The *Medical and Surgical Reporter* gives the following nomenclature of pathogenic micro-organisms, according to the accepted recent definitions of Dr. J. Schroeter: *Micrococcus vaccinæ* (Cohn), the active portion of vaccine lymph; *Micrococcus decalrans* (Cohn), produces baldness; *Streptococcus erysipelas* (Koch), induces erysipelas; *Streptococcus diphthereticus*, active in diphtheria; *Hyalococcus pneumoniæ*, present in croupous pneumonia; *Hyalococcus beinzii*, causes the gregarina of hair; *Bacillus anthracis* (Cohn), produces anthrax; *Bacillus tuberculosis* (Koch), in phthisis; *Bacillus leprœ* (Hansen), in leprosy; *Bacillus typhus* (Eberth), in typhoid fever; *Microspora comma* (Koch), induces Asiatic cholera; *Microspora finkleri* (Koch), present in cholera nostras; *Cladothrix fœrsteri* (Cohn), found in diseases of the lachrymal ducts.

HOUSE-FLIES AS CARRIERS OF TUBERCULOSIS CONTAGION.—Spillman and Haushalter have recently reported to the Academy of Sciences, (Paris, Session August 16th,) their investigations as to the possibility of "contagion" (bacillus) of tuberculosis being carried by house-flies, and the results make it extremely probable that these pests of our dwelling-houses and hospital wards may have much to do with the propogation and dissemination of such contagion.

These investigations included repeated examinations made of the excrements and intestines of flies that had fed on the contents of the spit-cups of consumptive patients; in both they found abundance of tubercle bacilli. They also found the same bacilli in the dried excrements of flies scraped from the windows and walls of rooms occupied by phthisical patients. The experimenters show how easily such germs may be disseminated by the dried excrements, or even by the dessicated pulverulent remains of the bodies

of these insects; how easily the air of respiration, or the food and drink, may be thus polluted and infected. It is known that the germs of the tubercle bacillus have great tenacity of life. These observers also indirectly strengthen the belief that the suitable soil is quite as essential to the development of tuberculosis as the suitable seed, otherwise the disease would inevitably be far more common even than it is.

Spillman and Haushalter, as a practical deduction from these investigations, insist on the importance of thorough disinfection of the spit-cups of tuberculosis patients, by means of strong solutions of phrenic acid or corrosive sublimate.—*Boston Med. and Surg. Journal.*

NEW ROTIFERS.—Ludwig Plate describes, in the seventh volume of the Naples *Mittleilung*, some new ectoparasitic Rotifiers from the Gulf of Naples. They belong to the family Seisonidæ, and, like all the other members of the group, occur attached to Nebalia. The forms described, four in number, belong to the new germs Paraseison, which is characterized by an absence of intestine, and has the wheel either as in Seison or reduced to tactile bristles, or, lastly, entirely absent. The other genera of the family—of which a synopsis is given—are Seison of Grube, with two species, and Saccobdella of Van Beneden and Hess, with a single species.—*Amercan Naturalist.*

GELATIN CULTURE TEST FOR MICRO-ORGANISMS OF WATER.—Dr. Charles Smart, U. S. A., concludes, in the Philadelphia *Medical News*, an extensive consideration of the micro-organisms of water with the following remarks in reference to the gelatin culture-test, which he believes to be valuable only in its doubtful promise for the future: "At present," he says, "in the hands of the sanitary inquirer, it gives but little information, and that little is surrounded on all sides by interrogation points. In the laboratory of the scientific investigator new methods may be discovered by which pathogenetic germs may be isolated and identified; but until that time arrives the sanitary analyst must depend upon the chemical results as translated in each particular instance by the aid of the ascertained sanitary environment of the water, and however much he may cultivate the microbes, he should not forget to inspect that other field of microscopic life (nostoc sytricha, kerona, algae, etc.) to which reference was made at the beginning of this paper."

THE GERMS IN VACCINE VIRUS.—Pfeiffer is quoted by *The Centralblatt für Bacterologie*, No. 19, 1888, in his report of examinations of vaccine lymph to determine the germs contained in it. He found that an absolutely pure lymph is only rarely obtained; the germs most frequently found are spores, rarely in lymph from children, constantly in vaccine lymph. Sarcinæ are also found in both human and vaccine lymph, but are of no practical importance. Bacteria and bacilli are found exceptionally in human lymph, more frequently in vaccine matter. Micrococci are found, the most constant being *Staphylococcus cereus albus*, and an orange-colored micrococcus identical with the *Pyogenes aureus*. Pathogenic micrococci occur frequently, most often the *Staphylococcus, pyogenes aureus, albus* and *citreus, streptococci*, those of erysipelas and the *pyogenes* are not found in animal lymph. The bacillus of syphilis does not flourish in bovine lymph and hence syphilitic contagion cannot be obtained from this source. The bacillus of tuberculosis may, however, be inoculated in vaccine lymph.—*Phila. Med. News.*

NEW METHOD OF CLASSIFYING BRYOZOA.—Instead of depending upon exterior characteristics for classification, the *Bryozoa* are ground into the required thinness and submitted to the microscope. The method of preparing these mounts is described in *Science* by Mr. A. F. Foerste. The specimen is ground on a Barnes machine, with emery until a plane is formed having the same direction as the intended section. The successively finer grades of emery are used until a fine polish is obtained, which can be made very fine indeed by using polishing powders sprinkled over a piece of plate glass. Then the specimen is carefully washed, dried, and glued with Canada balsam to the slide which is to retain the specimen. The specimen is then ground away until only a thin sheet remains fastened in the Canada balsam, after which it is again smoothed, washed and protected by a thin cover-glass.

NEWS AND NOTES.

THE cultures of the so-called micrococcus of cerebro-spinal meningitis show the cocci mostly joined in pairs, forming diplococci. They are round, but occasionally are seen flattened on their adjoining sides. There is a distinct space between them, equal to about one-third the diameter of a single coccus. They show no motion in the

hanging drop. They belong to to that class of bacteria denominated aerobic. The *New York Medical Journal*, of March 17, contains an interesting editorial resume of what has been written in regard to this organism.

* * With the greatly improved methods of analyzing the urine, both chemically and microscopically, which we now possess, not only albumen, but hyaline and granular casts, are found in the urine in very many diseases, such as the exanthemata, rheumatism, pneumonia, the various forms of continued fever, etc., as well as in apparent health, as after violent exercise, sea-bathing, severe mental emotions, after eating certain kinds of foods, as tapioca, or eggs in large quantities, in epilepsy or the eclampsia of children; but as a rule these temporary conditions are not dangerous, seldom requiring treatment.—C. S. Wood in *Medical Record.*

THE neglected twin nowhere proves his usefulness more than in microscopy. The observer who has his left hand properly trained has the purely right-handed one at an immense disadvantage. This is especially true in working with high, or comparatively high, powers. Try it and you will see. With the left hand to manage the stage and the right upon the micrometer adjustment, one can get over a slide in less than half the time occupied when the right hand is constantly leaving the adjustment to regulate the stage.—F. L. James, in *St. Louis Medical and Surgical Journal.*

DR. ERNEST WENDE, writing on the microscope in the diagnosis of skin diseases, says: The microscope has become of indispensable service in the diagnosis of these affections. The microscopical observer is necessarily confined to a skillful application of his instrument, looking behind and beyond any symptom or set of symptoms for an explanation, for a cause. Many are the impurities, both physical and organic, and many are the parasites both vegetable and animal, that are perpetually found giving rise to these conditions of which the symptoms are but mere expressions.—*Med. Press of West. New York.*

DR. E. L. NEALEY, of Bangor, read a paper on the "Use and Abuse of the Microscope" before the recent meeting of the Maine Medical Society. Our experience leads us to think that most physicians abuse the instrument by not using it.

SENGE'S experiments indicate that the ordinary antiseptics employed in surgical operations affect the kidneys by producing a

glomerulo-nephritis, an exudation taking place between the glomerulus and the capsule, and the epithelium of the tubuli contorti being almost entirely destroyed.

A WELL-KNOWN New York physician has just published the sort of discovery which Lord Lytton would have made a novel out of. An aged Polish count, formerly professor of languages and a famous oriental scholar, died in the hospital, and Dr. Rockwood had occasion, in conjunction with other experts, to make a microscopical examination of a certain part of the cerebrum. They noticed a peculiar set of markings, which took the form of Egyptian and Chinese hieroglyphics. These were amplified to a magnitude of 3,000 diameters, and the results shown to another oriental scholar, who declared them to be true characters in the Ethiopic, Syric and Egyptian languages. Dr. Rockwood suggests that his discovery will lead to extracting from the dead their literary achievements as well as their "suppressed opinions."—*Hardwicke's Science-Gossip.*

PROF. JOHN RYDE recently described, before the Philadelphia Academy of Natural Sciences, a ring-like prolongation of the placenta in embryo mice and rats, as indicating the descent of these animals from lower types in which the placenta is zonary.

DR. LUCIEN HOWE, of Buffalo, who went to Egypt last winter in order to study the bacillus of the opthalmia of the East, is now in Strassburg, Germany. Dr. Howe also incidentally investigated the leprosy of that country.

MYOSITIS, interstitial inflammation of muscular tissue, may be confused with sarcoma,—the microscopical appearances being quite similar. Only the most careful study of a number of specimens will enable the observer to differentiate the two conditions.

MR. CHARLES B. PLOWRIGHT, F. L. S., has written a work on The British Uredineae and Ustilagineæ. This will be illustrated with woodcuts and eight lithographic plates.

DR. J. W. MOTT advocates, in the *Botanical Gazette*, the application of the paraffin imbedding method in botanical research. He gives directions for the successful imbedding and preparation of vegetable tissues.

THE *Medical Record*, N. Y., illustrates an article on Thomsen's disease (myotonia congenita), with two microscopical drawings (?) of the affected muscle which bear a close resemblance to partial eclipse

of the moon. It would take a microscopist with a vivid imagination to appreciate these works of art.

H. W. CONN, in *Science*, concludes from the answers received from a large number of medical schools, in reply to circulars of inquiry, in regard to the germ theory, etc., that this theory has in the past few years been rapidly acquiring acceptance, is almost everywhere regarded as a subject worthy of most careful consideration, and is nowhere looked upon as an absurd speculation, as was the case a few years ago.

DR. DETMERS, of the Ohio State University, started for Europe June 15, to be gone about two months. The doctor expects to visit the laboratory of Dr. Koch and other similar institutions while on his trip, and be back in time to attend the annual meeting of the A. S. M.

BOOK REVIEWS.

THE MECHANICAL TREATMENT OF ABORTION. By H. W. Longyear, M. D. Reprint.

THE CONTRAS AND PROS OF THE CUTTER STEM PESSARY, ETC. By Ephraim Cutter, M. D. Reprint.

THE DISORDERS OF MENSTRUATION. By Edward W. Jenks, M. D. Geo. S. Davis, Detroit; paper, 25 cts.; cloth, 50 cts.

This excellent little treatise will be welcomed alike by student and practitioner.

PARTIAL SYLLABIC LISTS OF THE CLINICAL MORPHOLOGIES OF THE BLOOD, SPUTUM, FAECES, SKIN, URINE, VOMITUS, FOODS, INCLUDING POTABLE WATERS, ICE AND THE AIR, AND THE CLOTHING (after Salisbury). By Ephraim Cutter, M. D. Published by the author.

Dr. Cutter tells us that he has spent more than a quarter of a century in investigating the morphologies treated of in these pages. This, alone, should demand our consideration; but, aside from this, there is much curious and valuable information in the book. Dr. Cutter is a firm believer in the so-called Salisbury plan—and he writes, partly, in defense of this system.

THE INFECTIOUS DISEASES, Vol. II. By Karl Liebermeister. Translated by E. P. Hurd, M. D. Geo. S. Davis, Detroit, publisher. Paper, pp. 143–264,

This, the concluding volume, discusses the contagious diseases. The diseases more fully spoken of are Rubeola, Scarlatina, Variola, Varicella, Rubella and Diphtheria. The subjects are gone into exhaustively and deserve careful reading.

ALUMNI ASSOCIATION OF THE DETROIT COLLEGE OF MEDICINE; ANNUAL REPORT, 1888.

This is the first comprehensive report ever issued by the Alumni of this College, and will do much to advance the interests of their *alma mater*, as it contains full records of the college work done during the past year. The interests of a college demand the interests of its alumni, and we hope its association will continue to feel the interest so fully shown in the report before us.

To improvements in the construction of the microscope and its use are due in a great measure the important advance in our knowledge of the internal structure and development of plants and their parts.—*Western Druggist.*

CORRESPONDENCE AND QUERIES.

TO THE EDITORS OF THE MICROSCOPE :

In the April number of THE MICROSCOPE, there appeared a part of a personal report entitled "Note on a Fasoldt Test-Plate," by R. H. Ward, M. D., of Troy, N. Y., member of the committee appointed by the American Society of Microscopists to examine the test-plate made and presented to the Society by the writer. Not being in harmony with the assertions made in this report, I wish to make some remarks regarding it.

At the first examination, Dr. Ward, E. C. Fasoldt and myself were present, and at the last and most important, the above mentioned, and two gentlemen whom Dr. Ward brought with him, and Dr. T. F. C. Van Allen. Of the latter gentleman Dr. Ward makes no mention, but who, however resolved every band up to and including the 200,000 lines per inch in the presence of Dr. Ward, and who also accomplished it a number of times before. Dr. Ward having told me on the first occasion that his eyes were ruined from overwork, I asked Dr. Van Allen to be present at this final examination, to which he kindly consented.

In the report it is said that my son, Ernest C., could see 130,000 lines per inch, "and none beyond that." It is a grave mistake for the Doctor to make such an assertion, as my son said, after he had brought the lines in the field : "Doctor, here are the 130,000."

The Doctor, being unable to see them, and my son having another engagement, he took his departure.

A number of gentlemen have each, with the same microscope, objective, illuminator, and all accessories that we used when Dr. Ward, and the other gentlemen, were present, resolved all bands up to and including the 200,000, and others 150,000 and 160,000 lines per inch—seeing plainly lines and spaces. Two of the gentlemen have made reports regarding this, which may be found as follows: Dr. T. F. C. Van Allen in *The Microscopical Bulletin*, and P. H. Dudley, C. E., Vice-President N. Y. Microscopical Society, in the journal of that Society, January, 1888.

The successful resolution of the lines is not dependent on the mode of ruling, but on the *eyes*. And, considering the admitted inability in Dr. Ward's eyes, it would seem no more than an act of justice to all concerned had the Dr. delegated his position on the committee to some one whose eyes were more reliable, and who would have been especially unprejudiced as himself in making the investigations. Good eye-sight is certainly an essential factor in such close tests, as the resolution of even 120,000 lines per inch, and there may perhaps be a reasonable doubt whether the Doctor was able to resolve the 120,000 lines per inch, as he claimed he was able to do. His admissions are, however, very candid, and his report can, therefore, have no value as to the number or resolvability of the rulings under discussion.

Ruling on glass or metals is purely a mechanical process, and as such the inventor of a special mode of procedure is fully entitled to conceal his methods if he chooses to do so. I had thought it best for a time, at least, to keep the manner in which I make my fine rulings a secret. The reasons for doing so are too obvious, that it seems hardly necessary to state them. But I can assure the Doctor, and all others interested, that the process is purely mathematical, and there is no possible source of error to a careful manipulator.

Referring to "the peculiarity of this illuminator, aside from the oddity of its large size and square shape," I would say that it is no larger nor more "odd" in shape than the nature of the construction or mode of working requires it. A new working device may have a new form without it being criticised and stamped as "odd." Neither will it do for any man to consider himself the author of the first commandment.

Referring to the sentence that I did not seem to recognize the lines nearly as far up in the series as 120,000 lines per inch: if this were the case, how could I say that there are lines there? When ruling, I naturally have to know that I am cutting lines, and when I rule 50,000 lines per inch, I have to see that there is room enough for three more lines between a divison of that denomination; otherwise it would be useless for me to assert that I have ruled 200,000 lines per inch. Besides, I did not consider myself one of the committee, and did not have anything to say.

Answering the question that Dr. Ward put regarding the retinal impressions: Each person, when observing the lines, did not run over the whole 23 bands consecutively; but rests were made at intervals for some minutes, and when the highest attainable band was reached it was allowed to remain untouched for some time again, so that the observer might convince himself if he did really see what he claimed—seeing plainly lines and spaces—and that it was no retinal impression of the lower bands. However, the eye will not hold the image a great length of time.

Further, Dr. Ward asserts that the lines should be counted and measured, which would be very tedious and uncertain work without a microscope and micrometer, as I have constructed them, viz: for fine measurements and resolutions. Regarding which, the late Dr. J. J. Woodward said that it worked "with great precision." And were they compared with a micrometer one per cent. short, the 100,000 would be—according to that micrometer—only 99,000 lines per inch. Does the Doctor wish to insinuate that I try to deceive those interested therein by saying that there are 150,000 or 200,000 lines per inch when they are not ruled in so high a denomination? Dr. Van Allen counted the end lines of 190,000, which are virtually 95,000 lines per inch, and said that it was a severe strain on the eyes. I place my microscope for the use of anybody who wishes to count and measure the lines, and he may convince himself of the correctness of the ruling by comparing it with the U. S. standard, which, after a number of months of measurements was placed as a standard by the officers of the U. S. Coast Survey, and Dr. J. J. Woodward.

We cannot measure the lines proper, but we can measure the image, and here the illumination will have to be taken into consideration, which was not done by the "Committee on Micrometry," of which Dr. Ward and Prof. Rogers were members, when they

ordered the copies of the standard to be made by the writer several years ago. Owing to this omission, it is said that the copies are 3 in. too long, according to their measurements. The copies that I ruled were made to be used by transmitted light. But I am informed that the comparisons were made by illumination through the objective. The image received by the latter illumination will be longer than the one received when using transmitted light. There is also a difference between plain and concave mirrors and day and lamp light. The committee should have known that, or, knowing it, should have stated the methods employed for comparing the measurements. All questions of scientific interest should be approached with candor, and all sources of error should, so far as possible, be eliminated. Had this been done in this instance, the source of error, if error there was, might have been discovered to the satisfaction of all parties. The animus of the report is, perhaps, best explained in its concluding paragraph, which is as follows: "The members must look to Prof. Rogers for copies," etc. Now, being that Prof. Rogers was on the committee, why did he not make the copies in the first place?

CHAS. FASOLDT, SR.

ALBANY, N. Y., June 6th, 1888.

W. F. E., N. Y. City.—The little objects to which you refer are mucous (also called salivary) corpuscles. The little bodies "dancing about with the greatest activity" are indulging in the so-called Brownian or Bruonian movement. You can find full information on the subject in any good text-book under head of Brownian Movement.

H. E. V., Boston, Mass.—The distance from the eye-lens to the paper should be the same as from the eye-lens to micrometer on stage.

E. D., Sandusky, Ohio.—To permanently preserve uric acid crystals: A drop containing a number of the crystals is placed on a slide and protected from the dust, allowed to dry without heat; when thoroughly dried, a drop of turpentine is added. When the turpentine has nearly evaporated, mount in Canada balsam.

EXCHANGES.

This department is for the benefit of SUBSCRIBERS *who have microscopical apparatus, material or books which they wish to exchange, and such wants will be* INSERTED FREE OF CHARGE. *The number of insertions given will depend upon the number of exchanges received each month. Subscribers will please notify us when articles have been exchanged or sold. Dealers are referred to our advertising department.*

WOOD ENGRAVER'S TOOLS, BOOK, Etc.—Cost about $10, for a 1 inch Huy. Ocular, adapted to B. & L.'s "Model," slides, books or cash.
A. E. WARREN, Rio Vista, Virginia.

FOR SALE.—Zentmayer histological stand, Rack coarse adjustment, micrometer fine adjustment, B eye piece, good as new. 40 per cent. discount. Also, objectives 1½ and 8-10 Zentmayer, first class, and B. & L. ½ inch.
A. G. FIELD, M. D., Des Moines, Iowa.

GOOD HISTOLOGICAL SLIDES FOR OTHER GOOD MOUNTS.—I will cut good Histological or Pathological material on shares for those not provided with microtomes.
S. G. SHANK, M. D., 547 Clinton Ave., Albany, N. Y.

FOR EXCHANGE—Mounted sections of injected human kidney.
GILMAN DREW, 104 Bloomington St., Iowa City, Iowa.

WANTED—"Synopsis of North American Lichens," Tuckerman, and "Manual of the Mosses of the United States," Lesquereux & James. Will give fine slides or cash.
H. M. RICHARDS, 27 Ellery St., Cambridge, Mass.

FOR EXCHANGE—Good mounts of double-injected kidney, Trichina Spiralis, Fallopian tube of kitten and a variety of tumors for good pathological or histological mounts, or for sale at 15 cents each. C. B. CLAPP, Danville, Ill.

FOR SALE—A Hildebrand Microtome, with knife. Price, $10. Address
W. J. NEW, No. 32 W. Noble St., Columbus, Ohio.

FOR SALE AT A BARGAIN—A collection of histological slides.
ARTHUR LOEWY, Oak Park, Cook Co., Ill.

FOR SALE—A Tolles 1-12 in. objective, a very fine lense and practically new, having been used only a few times. Cost $100, and will be sold for $60.
Address, E. K. BAXTER, Sharon, Vt.

SLIDES FOR EXCHANGE—Peristomes of Moss and Diatoms, for miscellaneous mounts and material. Address, Dr. E. D. BONDURANT, Tuskaloosa, Ala.

SPECIMENS OF UTAH ROCKS AND MINERALS; also natural deposits from the mineral lakes and springs of Utah and Idaho, in exchange for good mounts.
Address, PROF. J. E. TALMAGE, P. O. Box 75, Provo City, Utah.

WILL EXCHANGE COLE'S STUDIES IN PATHOLOGICAL HISTOLOGY, Vol. III, for Cole's Studies in Animal Histology. Vol. II or IV. I offer full text and 12 slides and desire the same in exchange.
A. B. AUBERT, Maine State College, Orono, Maine.

FOR SALE—A Bausch & Lomb "Professional" Microscope, complete, nearly new. Catalogue No. 561; list price, $185.00. Best cash offer wanted—— ——?
J. H. SMITH, M. D., 909 S. Charles St., Baltimore, Md.

FOR EXCHANGE—Synopsis of the Diatoms of Belgium, by Dr. Van Henrck, 132 plates unbound. Will sell, or exchange for an Abbe Condenser, or a good laboratory microtome and pay difference in cost. F. J. SCHAUFELBERGER, M. D., Hastings, Neb.

FOR SALE—Slide of Bacillus Tuberculosis (from Sputum) single and double-stained.
Address, WM. B. CANFIELD, M. D., 1010 N. Charles St., Baltimore, Md.

WANTED TO PURCHASE—Second-hand copies in good condition of Rev. Wm. Smith's "British Diatoms," and "New Greville Plates of Diatoms."
JAMES B. SHEARER, Bay City, Mich.

FOR EXCHANGE—Diatomaceous earth from the plateau of Thibet (12,000 feet) varieties localities; also material and slides from localities in Scottish Highlands. Wanted, slides of American Diatoms, Insects and Botany.
W. D. STEWART, 2 Gilmore Terrace, Edinburgh, Scotland.

FOR SALE—A physician's microscope, manufactured by Bausch & Lomb; 2 eye-pieces; 2 objectives, 3-4 and 1-5; micrometer and camera lucida. For further particulars address A. W. ALLEN, 410 Grand River Ave., Detroit, Mich.

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VOL. VIII. DETROIT, AUGUST, 1888. No. 8

ORIGINAL COMMUNICATIONS.

FORM, ENDINGS AND RELATIONS OF STRIATED, MUSCULAR FIBERS IN THE MUSCLES OF MINUTE ANIMALS (MOUSE, SHREW, BAT AND ENGLISH SPARROW.)*

[THREE PLATES.]

SUSANNA PHELPS GAGE, PH. B.

PART I.

IN Kölliker's †Histology, (1867) p. 158, occurs the following statement: "In short muscles (the side muscles of fish, the limb muscles of the bat and the muscles of the frog) all the fibers are of the length of the muscle and have rounded ends. In long muscles the fibers are from 30 to 40 mm. in length. Far more numerous investigations are necessary to determine whether in all muscles of less length than 30 to 40 mm., the fibers are as long as the muscle itself." Since 1867 investigations as to the form and length of muscular fibers have not been numerous and, as far as I know, have been turned exclusively in the direction of man and the larger animals.

In order to carry the knowledge of the more obvious structure of muscle a step farther it was thought desirable to determine the length, form and relation of the fibers in minute animals. The larger part of the present investigation was made upon mice.

*The work on this article was done in the Anatomical Laboratory of Cornell University, and its main features were presented at the meeting of the American Society of Microscopists, August, 1887.

†For all references to authors see the alphabetically arranged bibliography at the end of Part II, where will be found briefly summarized the literature bearing directly upon this paper.

Several English sparrows were also studied, while only one shrew and two bats were examined.* The longest muscle found in these animals, the *latissimus* of a field mouse, was 27 mm. long, which is less than 30 mm., the number mentioned by Kölliker and usually accepted as the lowest limit of a fiber in a long muscle from any of the larger animals.

In general form the fibers of the trunk and limb muscles of these small animals are of three kinds—cylindrical, tapering and fusiform. Their arrangement is diagrammatically shown in Plate I., Figs. 1 to 9.

1. CYLINDRICAL FIBERS—Are those which extend from tendon to tendon of the muscle with a nearly uniform diameter (Fig. 1). In the shorter muscles these were the only kind found.† This was found to be the case in the intercostals (3½ to 4 mm.), the short muscles of the back (5 mm.) and the diaphragm (4 mm.) of the mouse and bat; the penniform muscles from both cephalic and caudal limbs of the mouse, bat and sparrow (the fibers varying in different muscles and in different parts of the same muscle from 1 to 7 mm.), and in the *rectus abdominis* of the mouse, a polygastric muscle, the sections between the raphes being 4 to 5 mm.

One of the longer muscles (10 mm.) from the shoulder of a mouse seemed also to be composed entirely of fibers which extend from tendon to tendon, while in the *latissimus* (25 to 27 mm.) of the mouse no fibers were traced the full length of the muscle. In some of the longer muscles the majority of the fibers extend from tendon to tendon, as in the *rectus capitis* (9 mm.) of the mouse. In others only occasionally could a fiber be traced from one end of the muscle to the other. This was done in the *vastus externus* of the mouse, a muscle varying in different specimens from 16 to 22 mm., and in the same muscle (9 mm.) of the bat, the shrew (8 mm.) and the English sparrow (14 mm.); in the pectoral (18 mm.), the *trapezius* (15 mm.) and the *obliquus abdominis* (14 mm.) of the mouse; in the rhomboid of the English sparrow and the *obliquus abdominis* of the bat. While there seem to be few cylindrical fibers in these longer muscles, their apparent rarity may be partially due to the difficulty of isolating them sufficiently to trace them.

2. TAPERING FIBERS—Are those having one termination large and more or less blunt at one tendinous attachment of the muscle,

* The species studied were the house mouse (*Mus musculus* [Linn]), both young and adult, the field mouse (*Hesperomys leucopus* [Raf.]), adult, the mole shrew (*Blarina brevicauda* [Say]), the brown bat (*Vespertilio subulatus* [Say]), the gray bat (*Atalapha cinereus* [Beauv.]), and the English sparrow (*Passer domesticus* [Linn]), both young and adult.

† For convenience the muscles may be classified as shorter, those 7 mm. and less between the tendons, and longer, those 8 mm. and over.

the other and tapering termination not extending to the other tendon but ending within the muscle. I shall call the two terminations respectively, the *tendinous* and the *intramuscular* end of the fiber. Figs. 2, 8 and 13 show the relative diameter of these fibers in their different parts, the middle section in each (*b*), the body of the fiber, should be greatly elongated, 40 to 100 times, in order to give an adequate idea of the real form of the fiber. Fibers of this kind were isolated in the *latissimus*, *trapezius*, *pectoralis*, *vastus externus*, *rhomboideus*, *obliquus abdominis* and *rectus capitis* of the mouse, in the *rectus capitis*, *rhomboideus*, *vastus externus* and two muscles of the brachium of the English sparrow, that is in both limb and trunk muscles. Intramuscular ends were also found where the fibers were not traced their entire length. Most such ends probably belong to tapering fibers. They are found in muscles varying in length from 5 to 27 mm. as the *latissimus*, *trapezius* and *pectoralis* of the English sparrow, the *latissimus*, *pectoralis*, *trapezius*, *vastus externus*, *obliquus abdominis* and one from the back of the bat, and the *latissimus*, *pectoralis* and *vastus externus* of the shrew.

In general it may be said that the longer the muscle, the more tapering fibers and intramuscular ends were found. There was no observable difference in number on account of the muscles belonging to the trunk or the limbs, nor on account of the species, as in the mouse and bat, nor the age of the animal as in the mouse and sparrow, nor the method of dissociation, whether by nitric acid or caustic potash, provided the specimen was quite fresh.

3. FUSIFORM FIBERS.—Are those which taper at both ends (Fig. 9). It seems probable that both ends are intramuscular as is so common in the larger animals. In the skeletal muscles only a few fibers of this type were found and these were from the mouse. There were two, each about 10 mm. long from the *latissimus*, a muscle 25 mm. long, one from the *obliquus abdominis*, one 2 mm. long from the *vastus externus*, a muscle 16 mm. long, and two others, each 7 mm. long, from the same muscle. The ends in the last named case are clearly intramuscular. In all of these cases the diameter of the fiber is small, that is about one-half the average size.

4. LENGTH OF TAPERING FIBERS.*—The length of the isolated fibers mentioned under 2, vary in the sparrow from 4 mm. in one muscle (8 mm. long) from the brachium, to 10 mm. in another muscle (18 mm. long) from the brachium; and in the mouse from 6 mm. in the rhomboid (10 mm. long) to 14 mm. in the pectoral (18 mm. long). A

*The fibers, the length of which is here given, were dissociated *in situ* (see methods Part II), so that only slight allowance need be made for shrinkage.

frequent length of tapering fibers in both animals is 6 to 9 mm. and generally speaking, they are from one-half to two-thirds the length of the muscle in which they occur, but occasionally, as in the rhomboid, which is 9 mm. long, and the *rectus capitis*, which is 5 mm. long, they extend from one tendon nearly to the other.

Owing to the difficulty of preparation, perfectly isolated tapering fibers are comparatively few, hence it seems desirable to confirm the above statement by other facts. (*a.*) Intramuscular ends of fibers which were not traced to the other end, are generally found near the middle and in the middle third of the muscle and only occasionally near the tendon. Of the last, some perhaps may belong to fusiform fibers (see 3). (*b.*) In dissecting thoroughly dissociated muscles by needles, an apparent rupture sometimes occurred at about the middle of the muscle. This proved, upon examination, not to be a tear, but on each side of the break were found groups of tapering intramuscular ends which evidently had interdigitated, and which belong to fibers, somewhat over half the length of the muscle, coming from opposite tendons. (*c.*) The examination of serial transections of the *vastus externus* of the mouse shows that while occasionally not far from a tendon is a fiber of very small diameter, that is the tapering end of fiber, the majority of such ends is near the middle of the muscle (Figs. 19–21).

From all these facts it seems justifiable to say that tapering fibers in these animals are generally from one-half to two-thirds of the length of the muscle in which they occur, that is from 3 to 18 or 20 mm. long, with an occasional one which is nearly as long as the muscle itself.

5. DIAMETER OF FIBERS.—Fibers from the mouse show in transection a great variety of form, being circular, triangular, quadrilateral, etc. (Fig. 19–22). Isolated fibers from all the small animals examined gave evidence of a similar variety in form, some of them when twisted show that they are even ribbon-shaped. The intramuscular ends approach more nearly to the cylindrical form than the fibers at their full size, as seen in section (compare Fig. 20 and 22), but even here they are often irregular (Fig. 21). In isolated preparations the simple tapering form of intramuscular end (Fig. 2–4) gives the appearance of a more regular cylindrical form than a branched ending does, as shown when an end rolls over or is twisted, while the tendinous ends frequently appear thin and much expanded laterally (Fig. 6), or compressed and tapering (Fig. 5). From these facts it is seen that though the type of the fiber is either cyl-

indrical or tapering, the deviation from the type is in all directions and at all parts of the fiber. These statements are based upon specimens subjected to reagents, as no determination of the form of the fiber was attempted on fresh material.

The measurement of the diameter of fibers offers serious difficulties. Apparently the most simple method would be to measure the sections of fibers, but this was abandoned owing to the inconstancy of the fascicules (see Part II.) and consequent difficulty in tracing the individual fibers through a series of sections in order to find where they are of full size. In isolated preparations, though it is not so difficult to determine what part of a fiber to measure, there are two sources of error. In the dissociating agents used, the fibers shrink in length, and consequently increase in diameter, and though the two diameters at a given point may be so different, as shown in sections (Fig. 20), only one of them can ordinarily be measured. The average diameter of twenty fibers from the *vastus externus* of the mouse, in the fresh state, was 50 μ—the largest and smallest being 80 μ and 30 μ; the average of thirty fibers dissociated in caustic potash and showing a decided shrinkage in length was 53 μ, the largest and smallest being 80 μ and 30 μ; the average of thirty fibers, dissociated in nitric acid *in situ*, and having a shrinkage of one-ninth their length, was 56 μ, the largest and smallest being 100 μ and 20 μ; the average of thirty fibers dissociated in nitric acid, and having a shrinkage of one-third in length was 70 μ, the largest and smallest being 100 μ and 30 μ. In the other animals studied, the average diameter of the fibers was considerably less.

Tendinous ends were found varying from 20 μ to 125 μ, and intramuscular ends from 2 μ to 20 μ, depending on the bluntness of the end and the part measured.

According to Rollett (1856) fibers which end within a muscle are small in diameter throughout their whole length. He assumed that they are developing fibers which do not yet reach from tendon to tendon. In the mouse and sparrow this is clearly not the case, as some fibers which extend from tendon to tendon are small and others large, while some tapering fibers with intramuscular ends are large (Fig. 12) and others small (Fig. 8). In the *trapezius* and the abdominal muscles of the mouse, fibers which extend side by side from tendon to tendon, show a great difference in size, one being three or four times as large as another (Fig. 6 and 8, and also Fig. 47, Pl. XII in Part II).

6. IN THE SKIN AND MUCOSA so clear a determination of the

general form and relations of the striated muscular fibers could not be made. In the skin the connective tissue does not yield to reagents until the fibers are too much softened to be dissected well, and in the tongue and œsophagus the fibers are interlaced in such a way as to make it difficult either to dissect them out or to trace them under the microscope in their natural relations. In the skin of the ear of the mouse, however, the circumstances are more favorable, and it was found that there are only cylindrical fibers which are very short $\frac{1}{2}$ to 2 or 3 mm. *In situ* these are seen to be arranged in small bundles and the bundles are placed at a variety of angles with each other. In the long skin muscle of the back no cylindrical fibers could be traced in either the bat or the mouse. A few tapering fibers and one fusiform fiber (6 mm.) were found in the mouse.

Of the large number of fine tapering ends found in the skin muscles of the back it was often impossible to determine whether they were intramuscular or terminated in the corium. A few were found *in situ* part of these being closely attached to other fibers and part ending in the corium.

In the tongue of the mouse and bat there are groups of parallel fibers, the terminations of which are at about the same level and apparently in the corium. Their relative position is shown in Figs. 28 to 30. The ends are usually wider than the body of the fiber (Fig. 28). A few short fibers, about 2 mm., were isolated from the tongue of the mouse, each of which had two such endings.

In the œsophagus of the mouse and bat two layers of striated fibers were found which extend to, but not upon, the stomach. In the centimeter next the stomach there were also numerous unstriated fibers. A few short, striated fibers, about 2 or 3 mm., were isolated. They taper somewhat toward the end but generally at the end again spread out (Fig. 24).

In these positions the fibers have a much smaller average diameter than in the limb and trunk muscles, being about one-half as large.

7. TYPES OF INTRAMUSCULAR ENDS.—Rollett (1856) first described and figured intramuscular ends of a simple tapering form. In all the animals considered in this paper, such ends were found in many of the skeletal muscles having tapering fibers (Figs. 2 and 4). They are found occasionally in the mouse and shrew, frequently in the bat and are the predominant form in the English sparrow.

Biesiadecki and Herzig (1858) showed that in the horse, frog and *Lota vulgaris* are found dichotomously divided ends within the

muscle and that, in the horse, from the side of some fibers extend "short hook-like appendages," compare Fig. 11. Branched endings have been figured also from the ocular muscles of the sheep (Tergast), the iris of birds (Dogiel) and some muscles of the cat (Gage).

In the mouse intramuscular ends in limb and trunk muscles are very numerous and have great variety in the form of the branching. The figures in Plate VIII and IX, though not all taken from the mouse, were found in prototype in that animal. The branches may be near the tip (Fig. 6), or arranged at intervals along the side of the fiber until it is of full size (Fig. 13), or the branches themselves may branch (Fig. 17). In the shrew many branched endings were found and the forms varied nearly as much as did those in the mouse. In the bat only two branched endings (Fig. 16) were found but the state of the specimens might account for this, as to demonstrate branched endings it seems necessary to have perfectly fresh material. In the sparrow branched endings are rare and the form of the branching shows less variety and is less marked (Figs. 10 and 11) than in the mouse or shrew.

A few endings both tapering and branched, which could strictly be called intramuscular, were found in the skin of the mouse (Fig. 7), while in the tongue one tapering and slightly branched end was found which was surely intramuscular.

The length of the taper before the fiber attains full size varies greatly, in some cases where the fiber breaks up suddenly into branches near the tip, being only 1 mm., in others extending 5 to 6 mm. It is usually, however, found to be 2 or 3 mm., and may be said to be from one-eighth to one-fifth of the length of a tapering fiber.

8. TYPES OF TENDINOUS ENDS.—The tendinous end of fibers, as usually figured, resembles the ends of Fig. 1 and 5, being either slightly compressed, pointed or truncate with short, finger-like divisions. In the small animals these forms are in the majority, but there are also found many endings of quite different forms. Fig. 4 shows a form in which the whole end (*t.*) has a great number of fine, short processes, with no striation, giving it a fringed appearance. This form was met with in the mouse, bat and sparrow, and in both nitric acid and caustic potash preparations. Figs. 6 and 32 show tendinous ends of various forms, being cleft or having both large and small branches. Some of the branches are given off as far as $\frac{1}{2}$ mm. from the tendon. Forms of this description were found in limb muscles

of the mouse, bat and sparrow, and in the *obliquus abdominis* of the mouse.

An extreme case of division at the tendinous end was found in a short fiber, 4.5 mm. long, from a penniform muscle of the antebrachium of a mouse (Fig. 34). The division extends about 1.5 mm., one-third the length of the fiber.

For convenience, the large branched endings of fibers from the skin and mucosa will be classified with the tendinous ends. Their position at the end of the muscle, and their size in relation to the body of the fiber to which they belong, give them a much closer resemblance to the tendinous than to the intramuscular end of fibers from limb and trunk muscles. In form, their resemblance to tendinous ends can be seen by comparing Figs. 24, 31 and 33 with Figs. 6 and 32. Frequently, however, these ends become much expanded laterally (Figs. 27–30). They often have fine, hair-like and root-like branches or processes (Fig. 27), which may be compared to those of Fig. 4*t*, and Fig. 6*t*. These forms are similar to those figured by Busk and Huxley in the skin of the rat's lip, to those described by Kölliker, and figured by Biesiadecki and Herzig in the frog's tongue, and to those figured by Margo from the alimentary canal of invertebrates.

9. BRANCHING OF FIBERS AT FULL SIZE.—Besides the branching already mentioned, there occurs occasionally in the limb and trunk muscles of the mouse, bat and shrew, a more or less equal division of the fiber at its full size into two parts. This is of frequent occurrence in the fibers of the tongue and œsophagus of the mouse and bat (Fig. 26).

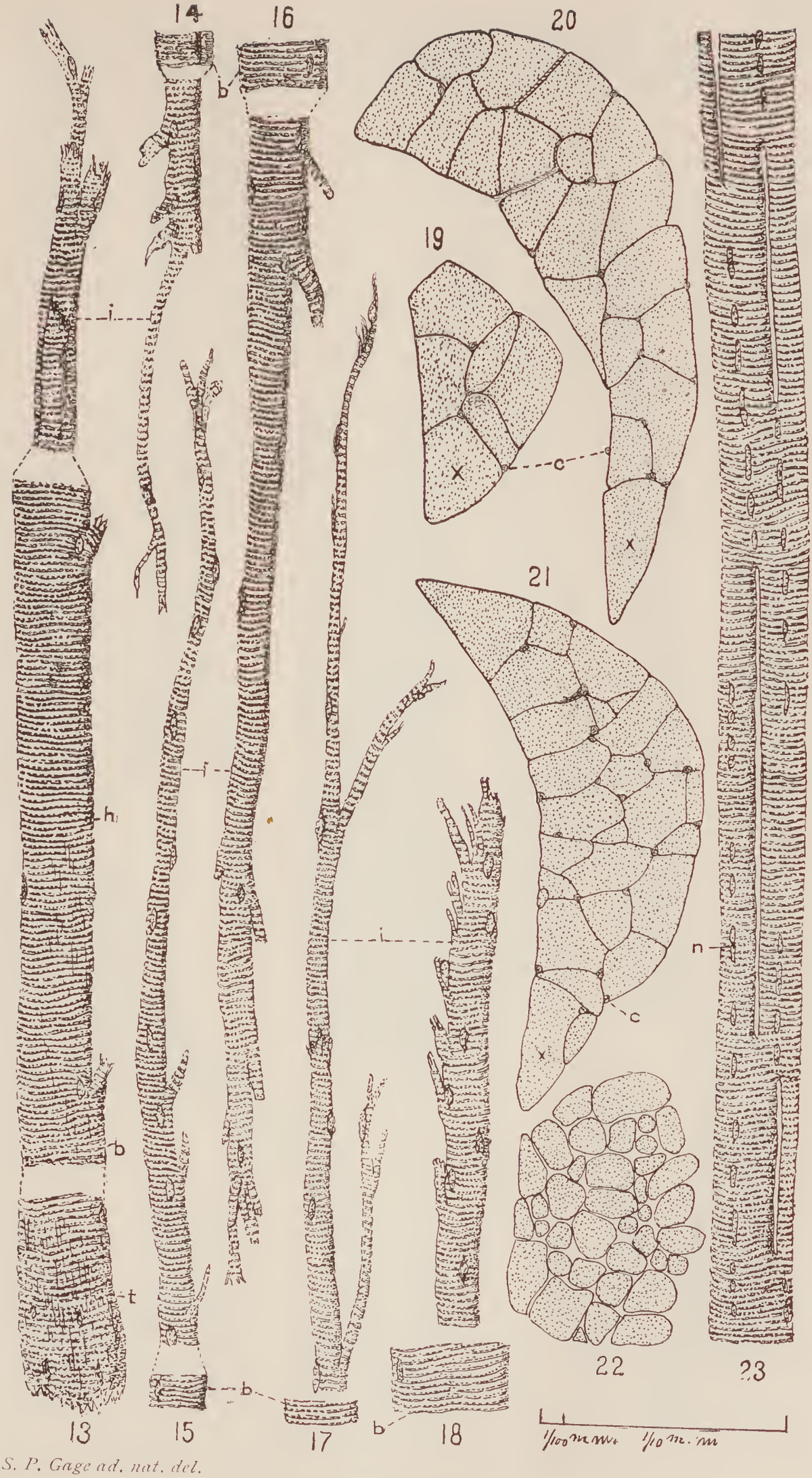
10. The fiber represented by Fig. 23 is a unique example, showing a fiber which appears to be splitting longitudinally. The clefts in the specimen have the clear outlines of a natural contour and do not at all resemble artificial tears. A noteworthy feature of this fiber is the longitudinal rows of nuclei, some of them dividing, which extend from the ends of the clefts. In works on development of muscle it is frequently asked if fibers multiply in number by longitudinal division. No valid conclusions could be drawn from one example.

SUMMARY.

From the above it will be seen that in small animals muscular fibers may extend from tendon to tendon, or one or both ends may terminate within the muscle. The difference in this respect between these and the larger animals is chiefly that in the latter there are many more spindle-shaped fibers with both ends intramuscular.

S. P. Gage ad. nat. del.

PLATE VIII.



S. P. Gage ad. nat. del.

PLATE IX.

S. P. Gage ad. nat. del.

PLATE X.

Tapering fibers are generally one-half to two-thirds the length of the muscle in which they occur, the length relatively to the muscle being much greater than in the larger animals.

The average diameter of the fibers at full size is generally about 30 μ to 70 μ, which corresponds closely with the number given for man.

In the limb and trunk muscles and those ending in corium, the tendinous end, the body of the fiber and the intramuscular end may be simple or may branch. In the larger animals isolated cases of branching, intramuscular ends have been shown, while in many animals, the endings in corium for a long time have been known to branch. Hence the generally accepted idea that a muscular fiber is unbranched from end to end is untenable.

EXPLANATION OF THE PLATES.

The drawings were made from the specimens with Abbe's camera-lucida. Except when otherwise specified, Zeiss' 8 mm. apochromatic objective and compensation ocular × 4 were used, but some of the details were determined by the Zeiss' 2 mm. apochromatic, homogeneous immersion objective.

The specimens are from muscles dissociated *in situ* in nitric acid, except when otherwise stated in the description of the figures

The intermediate part of the fiber marked *b* should be greatly elongated, 40 to 100 times, in order to give a correct idea of the form of the fiber. In the plates the comparative size of the fibers is graphically represented. In the limb and trunk muscles of the mouse, Fig. 6*t* is of the average size of a fiber. Fig. 9*b* is a small fiber, while a very large fiber is twice as large as Fig. 13*t*. In the skin of the mouse the average lies between *b* and *h*, Fig 7. That in the tongue is shown in Fig. 28*b*, in the œsophagus in Fig. 24*b*. The average in the limb and trunk muscles of the shrew is shown in Fig. 14*b*, of the bat in Fig. 4*b*, of the English sparrow in Fig. 5*h*.

PLATE VIII.

Magnification, 260 diameters.

Figs. 1 to 9.—These figures give a diagrammatic view of the form and arrangement of the fibers in the longer muscles of the mouse. Fig. 1 is of a fiber which extends from tendon to tendon. Figs. 2–8 are of tapering fibers with tendinous ends at opposite tendons and intramuscular ends at different relative distances from the tendons. Fig. 9 is of a spindle-shaped fiber with both ends intramuscular.

Fig. 1.—A typical cylindrical fiber which extends from tendon to tendon of the muscle. At the given magnification the diameter is that of many fibers found in the mouse, shrew, bat and English sparrow, while the length is that of one of the shortest fibers found in the skin of the ear of the mouse, that is $\frac{7}{10}$ mm. The ends, though different, are of types frequently found; one is tapering, the other truncate; both are made up of short finger-like processes. Nuclei are in places scattered irregularly, in places arranged in rows, and at the tendinous ends crowded together—and at *n* one shows signs of division.

Fig. 2.—A tapering fiber 7 mm. in length from a muscle 8 mm. long from the brachium of a young sparrow. Most of the intramuscular ends occurred in the middle third of the muscle, but a few fibers like this extended nearly its whole length. *t*, The tendinous end has very fine processes and is smaller than the body of the fiber, *b*. *h* Is two-thirds as large as *b* and is $1\frac{1}{2}$ mm. from the intramuscular end, *i*, which is a simple tapering end, a type common in the sparrow.

Fig. 3.—Part of a tapering fiber from the *trapezius* of a house mouse. The muscle is 20 mm. long and this end occurs near the middle. *b*, Body of the fiber; *h*, part of the fiber 1 mm. from the intramuscular end, *i*; both *h* and *i* have slight, bud-like, unstriated processes.

Fig. 4.—A tapering fiber from a muscle of the back of a gray bat. The fiber is 6 mm. long, while the muscle is 7 mm. *t*, The tendinous end has a great number of fine short processes, which give it a fringed appearance. It is larger than the body of the fiber, *b*. *h* Is $\frac{1}{2}$ mm. from the end, *i*, which has near its tip a projecting nucleus, giving the appearance of a process.

Fig. 5.—A tapering fiber 11 mm. long, from a muscle 18 mm. long, from the brachium of a young English sparrow. *t*, The tendinous end is small but rapidly expands to *b*, the body of the fiber; *h* is 3 mm. from the intramuscular end, *i*, which is a simple bifurcated form common in the English sparrow, less frequent in the other animals.

Fig. 6.—A tapering fiber from the *obliquus abdominis* of a house mouse. *t*, The tendinous end is of a type not uncommon in this and some other muscles; a number of similar ones were found *in situ*. *b*, The body of the fiber is smaller than *t*. *h* Is smaller than *b* and is 6 mm. from *i*, the bifurcated intramuscular end, a form not common in the limb and trunk muscles of the mouse.

Fig. 7.—A tapering fiber from the skin of the back of a house mouse. In the skin of the mouse this is not an unusual form of fiber, though the branches at *i* are generally shorter.

Fig. 8.—A tapering fiber from the *obliquus abdominis* of a house mouse. The branches are nearly at right angles with the intramuscular end, *i*, a condition not frequently seen in a free end. The whole fiber is small, being only about 18μ 6 mm. from the intramuscular end.

Fig. 9.—A fusiform fiber 7 mm. long from the *vastus externus*, a muscle 16 mm. long, of the house mouse. The two ends, *i i*, are both intramuscular and branched; the part *h* is 2 mm. from an end and is also branched. Dissociated in caustic potash.

Fig. 10.—Part of a tapering fiber from the *vastus externus* of a young English sparrow. The intramuscular end, *i*, is much branched, a form not common in the sparrow. The fiber has a gradual taper of 2 mm. to *b*, the body of the fiber.

Fig. 11.—The intramuscular end of a fiber from the *vastus externus* of a young English sparrow. It has a number of unstriated, bud-like processes. For 6 mm. from this point the fiber increases only slightly in diameter.

Fig. 12.—A tapering fiber from the *vastus externus* of the house mouse. *i*, The intramuscular end has many striated branches occurring from the third to the fifth tenth of a millimeter from the tip; the last $\frac{3}{10}$ mm. of the fiber is of a simple tapering form. The ends of the branches show plainly the same fringed appearance noted in the tendinous end of Fig. 4. This type of endings is frequent in the mouse and shrew. At *h*, 3 mm. from the end, the fiber is about two-thirds its full size.

PLATE IX.

Magnification, 260 diameters.

Fig. 13. A tapering fiber, 10 mm. long, from the *latissimus*, a muscle 27 mm. long, of an adult field mouse. The intramuscular end, *i*, has several branches seen both at the side and on the surface of the fiber; branches continue to be given off from the fiber until it is of full size at *b*, which is 3 mm. from *i*.

Fig. 14.—An intramuscular branched end of a fiber from the *pectoralis* of a shrew.

Fig. 15.—An intramuscular branched end of a fiber from the *pectoralis* of a shrew. Branches are given off at intervals for $\frac{4}{10}$ mm.

Fig. 16.—An intramuscular branched end from the *latissimus* of a gray bat. Branched ends are given off at intervals for $\frac{5}{10}$ mm.

Fig. 17.—An intramuscular end of a fiber from the *latissimus* of a house mouse in which the branches are long and give off secondary branches. This form of ending is rare.

Fig. 18.—An intramuscular branched end of a fiber from the *obliquus abdominis* of a house mouse. This end is rather more abrupt than those usually found. Dissociated in caustic potash.

Figs. 19–21.—Transections selected from serial sections of the *vastus externus* of a house mouse, to show the number, form and relation of the fibers in a fascicule (see Part II) at different points. *c*, Capillary. *x* Indicates the same fiber in each section. Fig. 19 is of a section about 1 mm. from the tendinous end of the muscle. It consists of six fibers, which show well the variety of shape. Fig. 20. A transection of the same fascicule at about one-fourth the length of the muscle from that shown in Fig. 19. The fascicule has increased in size by joining another, and is composed of nineteen fibers. Fig. 21. A transection of the same fascicule not far from the middle of the muscle. It has twenty-seven fibers, occupying about the same space as the nineteen of Fig. 20; most of the fibres are smaller, and some are very small. The latter are transections of tapering ends of fibers from the opposite tendon.

Fig. 22.—Transection of part of another fascicule from the same muscle at about the middle of its length. This gives an excellent idea of an appearance common in the middle of this muscle, and compared with Figs. 19–20 shows the relative diameter of fibers in the middle and near the tendon of this muscle. Figs. 19–22 are from specimens hardened in alcohol.

Fig. 23.—Part of a fiber from near the middle of the *pectoralis* of a house mouse. For three millimeters of its length it has clefts such as seen in the figure. The nuclei are arranged in rows extending from the ends of the clefts; many of them are apparently dividing, as at *n*, while some are very long. This fiber has a fine, tapering end, about 5 mm. from the part shown in the figure.

PLATE X.

Magnification of Figs. 24–31, 260 diameters, of Figs. 32–34, 180 diameters.

Figs. 24–27.—Fibers from the muscular coat of the cardiac end of the œsophagus of the house mouse. The ends are marked *t*; they are similar to those at the ends of the fibers in the tongue, but their relations were not made out. Fig. 24. A fiber 2 mm. long with both ends branched. Fig. 25. A branched end of unusual form, especially in the arrangement of the branches. Fig. 26. The body

of a fiber, bifurcated at its full size. Fig. 27. A very wide branched end.

Figs. 28 to 30.—Ends of fibers from the tongue of the house mouse, with the relative arrangement seen in the specimen. Such groups of ends found at the end of a bundle of fibers, apparently enter the corium of the mucosa.

Fig. 31.—Part of a fiber from the tongue of a house mouse, having groups of nuclei, *n*, near the end, *t*, and on the body of the fiber, *b*.

Fig. 32. A natural group of tendinous ends from the *vastus externus* of a house mouse. The form and size of the branches vary; some of them, as shown in the figures, are broken off. The branches are given off from $\frac{3}{10}$ to $\frac{7}{10}$ mm. from the tips of the fibers. On *W*, the part marked *t*, which approaches nearest to the end of *X*, is so small as to resemble an intramuscular end.

Fig. 33. The branched end of a fiber from the skin of the ear of a house mouse. This end is as great in diameter as the majority of the fibers in the ear.

Fig. 34. A fiber about 4.5 mm. long, from a penniform muscle of the antebrachium of a house mouse. It is cleft about one-third its length and the tendinous end of each portion, *t*, is branched.

ON THE PREPARATION OF TYPE-PLATES, AND ARRANGED GROUPS OF DIATOMS.

K. M. CUNNINGHAM.

IN the November, 1887, issue of THE MICROSCOPE there appeared an article on collecting and cleaning diatoms, being a statement of the results of my own experiences in that line, and near its conclusion I expressed the hope that I might be able at some future time to contribute an article on the methods employed in selecting and arranging the diatomaceæ. Since the article was written, I have been particularly fortunate to have personally met, while in Europe last summer, a large number of prominent diatomists, and, in most cases, have been shown the methods of work peculiar to themselves. Among these noted preparers I may mention J. Kinker, of Amsterdam; Mr. Firth, and Joseph Wright, of Belfast; Carl Gunter, Rudolph Getschmann and Dr. Otto N. Witt, of Berlin; Edward Thum, of Leipzig; Eugen Weisflog, of Dresden; I. C. Rinnbock, of Vienna; Eugene Burgone, Paris; Harold Dalton, Dr. Henry Stolterfoth, Chester, Eng.; Mr. Murray, in charge of the department

of Micro-botany, of the British Museum, and H. Morland, of London. A lengthy space would be required in which to detail the special lines of work in which the gentlemen named above have distinguished themselves; but all concur in adding lustre to the research and study of the Diatomaceæ or Foraminifera, as shown in the beautiful results attained by them.

While abroad, I secured a collection of the finer diatom preparations showing the skill of some of the parties already referred to. Herr Rudolf Getschmann, of Rixdorf, near Berlin, with whose preparations I am most familiar, proceeds in their preparation after the following method, which he demonstrated before me. A table is arranged before a well lighted window, and on this is placed the requisite appliances for work. The chief requisite being a small dissecting microscope, fitted with simple achromatic lenses, varying in their focal length as the case might require, but a lense of about a quarter-inch focus answering for actual work. Preparatory to beginning a selection of diatoms for the design to be arranged, a quantity of cleaned diatom material is evenly spread over an ordinary slide, this is carefully examined, and from it is selected all the perfect forms likely to be used in a design, and transferred to a cover-glass; all forms of the same shape being grouped together, or arranged in lines for convenience afterwards; if necessary, several cover-glasses can be thus filled with perfect forms, free from cracks or other blemishes, and placed aside, protected from dust until required. The diatoms are picked out from the spread layer of material, by the aid of hair bristles of varying degrees of fineness mounted in a slender wooden handle, and projecting therefrom about a half inch; the bristle should be straight, and, if possible, have a fine taper to a sharp point, this is handled, or used, with a free and steady hand, and, to facilitate steadiness in picking out, the two arms are rested upon two cushioned blocks of wood, tapering from the level of the stage of microscope to their bases on table. A further indispensable piece is a glass slide, having an area at its center of about a quarter of an inch, or somewhat less, ruled into minute squares, at the rate of about forty lines to the quarter inch; on this slide, and properly centered, must be placed the cover-glass upon which it is desired to produce the group. The cover-glass is prepared by spreading at its center a minute drop of liquid gelatine by means of a little brass spatula, and allow to dry. A number of cover-glasses, after having been carefully chosen and thoroughly cleaned, might be prepared and also set aside for use later. The clear and transparent gelatine should be filtered before use, by pass-

ing it through suitable filter-paper, so as to prevent all chance dirt from marring the mount. When ready to begin a group, fix the cover-glass centrally over the area of squares by means of three little touches of wax, and then also adjust, close to the same cover-glass, one of the cover-glasses containing the diatoms previously selected for the grouping; or, if necessary, two or more, according to the complexity of the proposed design. With the selecting bristle in the right hand, and the eye adjusted to the lens, bring the glass containing the selected diatoms into the field of view, then carefully select as a center, a perfect disc, say, a coscinodiscus; now shift the gelatined cover-glass into view and deposit the disc at its center, and carefully adjust it so that its center shall seem to cover the intersection of a group of the small squares; around the disc, as a center, adjust a series of small circular forms, space them at equal distances from each other. Should it next be desired to introduce a series of navicular or slender forms they may be adjusted into position by lining them over the guide lines radiating from centre of disc, or through the diagonals of the squares; in this manner proceed until the design is completed.

When the grouping is finally inspected, it is permanently fixed to the gelatine layer by holding the slide on a level, under the mouth, and breathing on it very carefully a few times. This is perfectly reliable and more expeditious than breathing through rubber or glass tubes for the same purpose.

For the purpose of mounting it is well to have a quantity of cells finished on slides and kept on hand. The slides are centered on turn-table and shallow cells of black shellac; are built up to suit the diameter of the cover-glass to be mounted thereon. This cell is filled with a drop of Canada balsam pressed out of a metal tube. The cover-glass containing the arranged diatoms is now freely immersed in filtered spirits of turpentine and also flushed with it, so as to expel all air from the diatoms and to clean off all motes or particles that may have lodged upon it during or after preparation of the same. The cover-glass is then set upon its edge to drain off superfluous turpentine, and while it drains, gently soften the the shellac cell over a spirit lamp, pick up the cover-glass and gently lay it centrally over cell, and press firmly into contact with the cell; the slide is then set aside with the cell side down, and supported on a level, to obviate as much as possible the floating out of place of any of the forms, which are sometimes displaced while drying.

The procedure described above is essentially that followed by

the leading preparers, with more or less slight variations as to finish of cells and media used in mounting.

For the arrangement of type-plates of diatoms, the guide-lines and squares ruled on the cover-glass carrier serves to easily allow the forms to be adjusted in lines and properly spaced with the same ease as in symmetrical grouping. When such beautiful results as I have seen are produced by simple and inexpensive means, it seems to be not worth while to attempt this class of work with compound microscopes with mechanical fingers and ruled guides set in eye-piece as seems to prevail in the United States.

In order that specimens of slides by Herr Getschmann may be appreciated, and at the same time answer the purposes or illustration, I add a plate sketched off-hand, showing two arrangements

made by him. The sketches, however, convey but an imperfect idea of the beauty and perfection of the originals, from which the sketches were made.

I trust that this exposé may encourage those who are pursuing the grouping of diatoms, for either pleasure or profit, to a complete success, and that on this side we may have a few names celebrated for the fineness and perfection of their work.

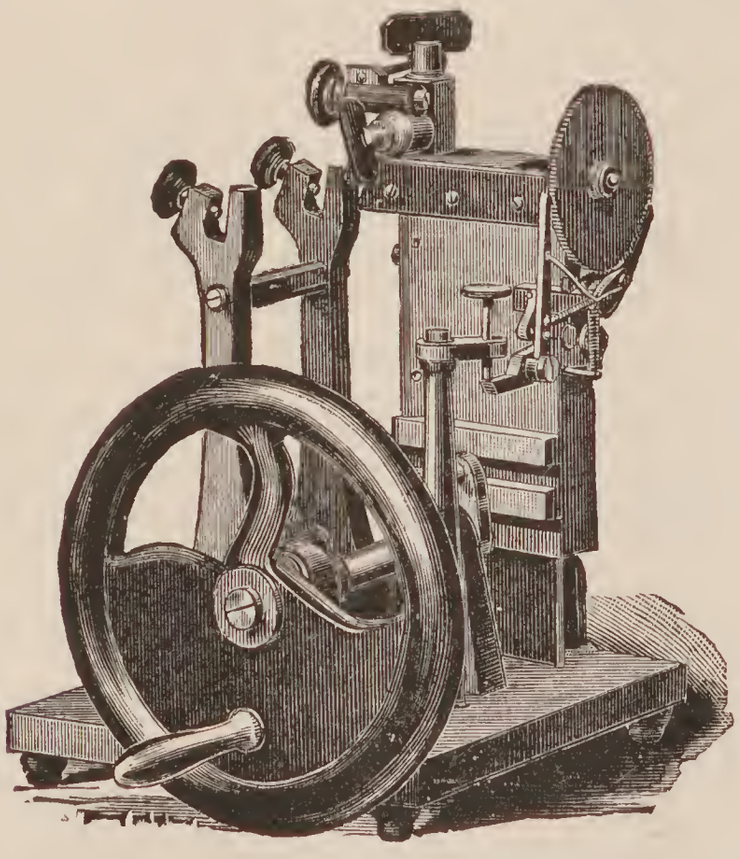
MOBILE, ALA.

DR. MINOT'S AUTOMATIC MICROTOME.

J. S. KINGSLEY.

THIS, the most recent of the many forms of apparatus for section-cutting, is, in the writer's opinion, the best of the automatic forms. Equipped with it, and a Thoma or Schanze instrument for celloidin sections, any laboratory may be considered as well prepared for any ordinary section work.

In the Minot microtome, the general features of which can be seen from the cut, the knife is stationary, while the object is moved. Motion is communicated either by a crank or by a belt to the balance



wheel from a water-motor. Each revolution of the shaft raises and lowers the object-carrier, the section being cut on the downward stroke. The object-carrier is advanced towards the knife, when at

its extreme height, by means of a micrometer screw placed between the ways on which it runs. This screw has threads $\frac{1}{2}$ millimetre apart, and the large wheel, which turns the screw, bears three hundred teeth upon its margin. This wheel is turned by means of a pall which strikes the slender upright, seen in the cut, while a set screw allows the pall to engage from one to twelve teeth at a revotion. Thus, the instrument has a capacity of cutting sections from $\frac{1}{25}$ mm. to $\frac{1}{300}$ mm., as desired. The object, imbedded in paraffin, is soldered with the same material to one of the section holders, and this is then placed in its proper socket and clamped. This part of the apparatus is provided with proper clamps and set-screws, so that motion is possible in the three dimensions of space, allowing perfect orientation of the specimen.

The present writer has used this machine for about three months almost daily, and it has proven itself all that could be expected. It is well made and simple, and it is an easy matter to cut with it ribbons three feet or more in length, without a break and without losing a single section. The microtome is manufactured by the Educational Supply Co., Hamilton Place, Boston, Mass. The price, with a *good* knife, is $40. If one desires, an ordinary razor can be clamped in the standard in place of the knife.

BLOOMINGTON, ILL.

PROCEEDINGS OF SOCIETIES.

THE A. S. M. MEETING, 1888—CHANGE IN DATE.

CHAMPAIGN, ILL., July 4, 1888.

THE date of the A. S. M. meeting has been changed by the Executive Committee to August 21, on account of the change of the A. A. A. S. meeting to August 15, instead of 22nd, as at first announced. My address for some weeks will be Bay View, Mich.

Truly yours,

T. J. BURRILL, *Secretary.*

We trust that every member of the Society will endeavor to be present at this meeting, and will add their little or much toward making it a success. The Columbus committee and local society have arranged an attractive programme, besides that of the regular session, and everything possible will be done to make the visiting members feel at home, and render the occasion one of great pleasure and profit.

Microscopists who are really in earnest cannot afford to absent themselves from these yearly gatherings, for, as we have before urged, the interchange of thought and the forming of new friendships, is a stimulus to renewed and better work, and in many ways of exceeding benefit.

A full report of the meeting will appear in our September issue.

GRAY MEMORIAL BOTANICAL CHAPTER OF THE AGASSIZ ASSOCIATION.

THE members of this Association reside in California, Minnesota, Wisconsin, Illinois, Ohio, Michigan, Missouri, Massachusetts, Connecticut, New York, Colorado and Kansas, and are mostly amateur botanists, isolated from the great centers with the facilities for study offered by public libraries, laboratories and schools. The aim of the Chapter is to create an enthusiasm and interest in the study of botany by means of correspondence and interchange of specimens.

We believe that this Association is capable of excellent work, and that the results will be of benefit not only to the individual members, but also to the communities in which they reside. We have only words of encouragement for those who undertake the study of nature, and the greater the obstacles in the way of such study the greater the credit and personal gain to the student. We hope that the members of this new Society will not neglect the microscopical study of plants, nor let the fascination of pressing, drying and mounting lead them away from work on vegetable histology.

THE ST. LOUIS CLUB OF MICROSCOPISTS.

THE regular monthly meeting was held Tuesday evening, July 10, with fifty per cent. of the members present. A. J. Hoenney, who was on the programme for the evening, was unable to be present. Frank Davis presented mounts of teeth from newly-born pigs, and explained the methods of growth. He stated that he was working with a dentist who expects to be able to announce some new theories about the nutrition of teeth. Prof. Whelpley reported on the microscopic examination of gum arabic, and showed crystals of oxalate of calcium formed by acidulating a mucilage of gum arabic with acetic acid, and precipitating with oxalate of ammonium. This is a new reaction for the gum.

The next meeting occurs August 7, at which date J. C. Falk and William Ilhardt will present subjects for consideration.

THE TROY SCIENTIFIC ASSOCIATION.

THIS Association held its eighteenth Annual Reception and Microscopical Exhibition May 21, 1888. Some one hundred and one slides were shown. There were three tables devoted to specimens—inorganic, vegetable and invertebrate. A noticeable feature of the exhibition was a *lemonade* table, which was, no doubt, approved by the guests of the Association.

ELEMENTARY DEPARTMENT.

A COURSE IN ANIMAL HISTOLOGY.

FRANK W. BROWN, M. D.

FOURTH PAPER.

THE CONNECTIVE TISSUES.—Connective tissue, in one or other of its several forms, is found in every organ and structure of the body, with the exception of certain epithelial surfaces and their offshoots, the hairs. Although its function is a purely mechanical one, serving to support the essential cells of an organ, or in its purer form as bone, to sustain the body, it plays an exceedingly prominent part in health and disease. There are few morbid changes in which it does not participate. Less complicated in structure and requiring less nutrition than the cells it sustains, its tendency in morbid processes, not destructive in character, is to increase, thriving at the expense of, and crushing out, the cells. In destructive processes, it is the last to yield, and when destroyed the first to become restored.

Though differing widely in appearance in their several forms, the connective tissues have much in common. They are developed from the same layer of embryonal cells, and show their relationship, when at maturity, by a tendency, under certain circumstances, to pass from one form to another. Composed in the embryo almost entirely of cells, they are, when fully developed, made up mostly of intercellular substance, the cellular elements being few in number. Finally, they are composed of chemically allied substances. The cells of connective tissue are of two sorts, (1) fixed cells and (2) wandering migratory or lymphoid cells. The former are the constituent cells of the

tissue, whilst the latter, quite like the leucocytes of the blood in structure, pass in and out, becoming permanent only when repair of the tissue is needed, to which process they contribute.

A rather arbitrary classification of the connective tissues can be made as follows: (1) fibrous tissue, (2) adipose tissue, (3) elastic tissue, (4) retiform tissue, (5) adenoid or lymphoid tissue, (6) gelatinous tissue, (7) cartilage, (8) bone.

FIBROUS TISSUE.—Select a small, spongy piece of subcutaneous tissue, free from fat, place in the salt solution and, when carefully teased out, cover and examine. Little wavy bundles of fibers will be found. They do not branch nor communicate, and have no apparent structure. The bundles do not run parallel, but cross and recross, leaving little spaces or areolæ—hence the name "areolar tissue," sometimes applied to this form of fibrous tissue. The fibers are held together by a homogeneous cement substance. In the interstices of the bundles an occasional connective-tissue cell may be discovered. It is generally flattened, branched, and contains a nucleus. In the firmer bundles of tissue the cell may be so compressed as to assume a spindle shape.

Fibrous tissue seldom exists in a pure state. In the specimen under examination a few fibers of another sort will be found. They do not run in bundles, are not so wavy, are branched, connect with each other, and curl at their detached ends. These are white elastic fibers.

Irrigate the specimen with dilute acetic acid. Whilst the elastic tissue remains unchanged, the fibrous bundles swell up and become transformed to a jelly-like substance. This swelling is sometimes accompanied by a curious phenomenon: the constriction of the bundles at regular intervals by little bands. The cause is unknown. It has been attributed to the twining of the cell-processes, or of the elastic fibers, about the bundle, or that the bundle possesses a sheath which has been destroyed by the acid, excepting at the point of constriction.

For the further study of fibrous tissue, examine the capsules of the liver and kidney, prepared by the teasing process. The bundles will be found loosely interwoven, and of coarser fiber. Examine further the serous membranes. Cut out a small piece of a frog's mesentery. Stain, if desired, in carmine or hæmatoxylin, wash in weakly-acidulated (acetic acid) water, and mount in a drop of glycerin. The fibers in the membrane run more parallel and are arranged in lamellæ.

For the study of the cells found in this tissue, the mesentery, prepared as just described, will answer. The intermuscular fasciæ, when spread out and stained, show numbers of stellate cells. Examine also the tail of a tadpole or the web of a frog's foot. The stellate cells will be found loaded with pigment, with the exception of the nucleus, which is generally clear.

ENDOTHELIUM.—These cells which cover with a single layer the serous membranes and line the various closed cavities, as the interior of blood-vessels, etc., have often been described in connection with epithelium. They are not, however, epithelial in character, but are fixed connective-tissue cells. They can be most easily demonstrated in the frog's mesentery as follows: Wash a small piece of the membrane carefully in distilled water, then immerse it in the silver-nitrate solution. Leave it there for two or three minutes, then remove and wash again. Now place it in a vessel of distilled water, cover with a glass plate and expose to the light—not direct sun-light, however—until it assumes a light-brown color. This usually takes a number of hours, during which time the water may be changed a few times. The color appearing, the membrane will have been sufficiently stained to show the outlines of the cells. This result is produced by the combination of the silver salt with the intercellular substance to form an albuminate, which, white at first, darkens on exposure. The specimen may now be stained with hamatoxylin, cleaned, dehydrated and mounted in balsam. In carefully focussing, the delicate network will come into view, blackened by the silver, the nuclei, large and delicate, taking the logwood stain.

EDITORIAL.

REAGENTS IN MICROSCOPY.

IT is unfortunate that circumstances (excepting, of course, in micro-chemistry), compel the use of reagents in microscopy, and too much care cannot be taken in the study of tissues to eliminate, as far as possible, the effects these reagents may have upon them. The hardening, the embedding, the staining, etc., of tissues, all tend to alter, somewhat, their apparent structure. In fact, the only ideal way to study organic objects is to employ fresh or living tissues, and to examine them under their natural conditions. Such a way, however, is impossible, and we must, through necessity, make use of chemicals, the effects of which on the tissues we oftentimes know little about. But we should not make a virtue of this necessity. We

should attempt to have our reagents as mild and innocuous as can be obtained, and their effects carefully studied before we draw conclusions as to the structure of the objects examined.

Trite as this may seem, it is, we think, often lost sight of by investigators, some of whom stand high in authority. Methods of preparation have been proposed for the brilliancy rather than for the correctness of their results; and examples are not wanting where, it would seem, a preconceived idea of structure had been forced to a demonstration.

As evidence for the truth of the former statement, it is only necessary to review the class of work being done to-day. Many are engaged in overhauling old methods and proposing new ones, for the reason that the older methods, though often giving more brilliant results, do not give correct ones. As an example, new hardening agents are coming into use. Alcohol and chromic acid and its salts are being displaced by materials which will not alter, though they may not harden the tissues so well. All this means more patience and care, and, in the end, less pretty though more truthful results.

In the latter case examples are rare. We shall, however, give one in explanation of our meaning, *i. e.*, Prof. Böttcher's method of demonstrating a nucleus in the mammalian red blood-corpuscle. The method is this: One volume of blood is mixed with fifty volumes of a saturated solution of corrosive sublimate in 96 per cent. alcohol. This is left, with an occasional stirring, for twenty-four hours. The corpuscles are thus bleached and preserved. After settling, the fluid is poured off and replaced with pure alcohol. In another twenty-four hours the alcohol is replaced with distilled water. The corpuscles, which have managed to preserve their identity after such an ordeal, are then stained with eosin or picric acid, and mounted.

It requires no skill to predict that when these exceedingly delicate and soft little bodies are treated to a prolonged bath in a saturated solution of corrosive sublimate in alcohol, *something* must happen, and it is a wonder to us that this something should be claimed as an originally structural part of the corpuscle.

In short, our efforts should be in the direction of truthful rather than beautiful specimens, although a happy combination of truth and beauty is not impossible. But the amateur thrives in every community who makes or buys slides because they are beautiful. How often one hears of a specimen: "How beautifully it shows this or that," when it may do nothing of the sort. The question should alwaysarise in the mind of the observer: "How beautiful the structure as thus prepared, but is it naturally so?"

The advanced worker is trying to make them true ; the amateur to make them beautiful, and we hope the day is not far distant when the two qualities can be combined.

WE should be pleased to see all our editorials so freely commented on as the one in our May number on thin sections. Prof. Stowell complimented us with his approval of the views expressed, and now comes Dr. Reeves with a reply intended to combat what he calls the "pernicious influence" of the same views. Without going into a lengthy discussion, we must say that we do not think that Dr. Reeves disagrees with us as widely as he imagines. He holds that had we stated the whole case, our position had been untenable; he, therefore, to show our error, "completes" our case by the addition of two important facts. We quite agree with him in the importance and correctness of these facts, but do not see that they have anything to do with the subject under discussion. Our differences can, we think, be thus summarized :

We believe that "the rule should be, then, not to make the sections as thin as possible, but rather to have them of a thickness that will include as many layers as can be clearly studied."

Dr. Reeves believes that "when the finest possible details of a histological or pathological specimen are sought by the aid of a high-power objective, a section just thick enough to hold the tissue elements together will not be too thin—the thinner the better, provided the section has been handled from beginning to end in the highest style of the beautiful art."

We have no objections to the "highest style," in fact we confess to being rather fond of it, but we still insist that our sections must have a thickness that will include as many layers as can be *clearly* studied; for the details of a specimen cannot be observed unless it is thick enough to show the arrangement of its parts. As for studying the finest possible details, such as the structure of, or changes in individual cells, no section, however thin, will serve the purpose. Other methods must then be employed.

We have examined the specimens referred to in his letter and find them, like all examples of his work, most excellently prepared and mounted. Our only criticism is that they were not quite thick enough to show the tissue relations to the best advantage.

DR. REEVES' idea regarding the benefits to be derived from a daily working session at the meetings of the A. S. M. should be encouraged.

We are confident that the experiment to be tried at the next meeting will prove a success, but in order to make it so, Dr. Reeves and other experts in practical microscopy should be on hand.

ACKNOWLEDGMENTS.—From Dr. James E. Reeves, Chattanooga, Tenn., three slides in the perfection of Dr. Reeves' well-known style; from Dr. H. H. Ganz, Clifton Springs, N. Y., sample of his "Eureka Bottle Covers." It strikes us that microscopists will find these covers very useful for covering reagent and stain bottles. They are simple and cheap, and commend themselves; from E. H. Griffith, cleaned diatoms from New Hampshire.

TECHNOLOGY.

PICRO-CARMINE.—*The Magazine of Pharmacy* gives the following method for the preparation of picro-carmine: Dissolve half a gramme of carmine in 100 cc. of water, to which has been added 5 cc. of a one per cent. solution of soda. Boil, filter and add sufficient distilled water to make 100 cc. of the stain. Mix with an equal volume of water, and add a one per cent. solution of picric acid. The turbidity thus produced soon disappears; if not, the fluid has been over-neutralized.

ABSTRACTS.

THE EGGS OF THE GNAT.

IN some notes on the development of the gnat, contributed by Mr. Harry Thomas to *Science Gossip*, the writer says: "The female gnat lays her eggs, arranged spirally, in a sausage-shaped, colorless jelly, varying from one-quarter inch to one inch in length, beneath the surface of still waters. I obtained specimens during the months of August, September and the early part of October. They were found usually attached to the side of the vessel, by an adherent disk terminating a prolongation of their upper extremity just beneath the water; but sometimes unattached, suspended several inches beneath the water, when the disk reaches to and floats upon the surface. When first deposited, the eggs are closely packed together, forming a short, brown string. In a very short time the connecting envelope absorbs the surrounding water till it has

increased to many times its original bulk. The eggs then become separated and form an inner spiral chain. Slightly magnified, the egg-case appears divided into many equal segments by narrow transparent rings; and two transparent threads, twisted with each other, may be traced from the neighborhood of the lower to the upper extremity, where they unite and are continued beyond as a single thread terminating in an adhesive disk. The eggs appear somewhat oval in form, and are arranged in a spiral which shirks a complete turn, and when all but round, makes a loop and goes back again. The nearly completed rings thus formed lie each within a separate segment."

MUSCLES OF MOLLUSCS.—There are frequently described in molluscs striated muscles, sometimes of a peculiar type. Müller and Keferstein have described them in the hearts of Cephalopods and in the pharynx of the Cephalophora; Blanchard in the adductors of Pecten, and Paneth in the fins of Pteropods and Heterapoda. Schnalbe has described in the adductors of the lamellibranchs and elsewhere muscles with a double-oblique striation, while, before him, Mettenheimer, Wagener and Margo had referred to the same appearance as spiral striation. Lately, Fol (*Comptes Rendus*, January, 1888), has investigated the same subject, and concludes that true striated muscles do not exist in any mollusc. All cases reported as such, in reality consist of smooth fibers, around which fine fibrils are rolled in a spiral manner, this being the case in all the special instances noted above. The method employed by Paneth (glycerin and nitric acid) produced such contraction that the spiral fibrillæ really appeared transverse. All of the molluscan muscles are of the smooth type; but these are to be grouped in two subdivisions—that already mentioned, and that in which the fibrillæ are straight. The latter are the more abundant. Judging from their distribution, the spiral type are of value where a rapid contraction is needed.—*American Naturalist.*

TUPELO WOOD IN SECTION CUTTING.—A correspondent of *The Microscopical Bulletin* writes: I see from one of the pharmaceutical journals, that a German microscopist recommends tupelo wood (*Nyssa candicans, michix*, etc.) for use in section-cutting, which grows in the Southern United States, not far from the sea coast. It is stated to be superior in several respects to elder pith, sunflower pith and cork. In hardness the wood is intermediate between elder pith and cork.

NEWS AND NOTES.

THE *Medical Register* reports the case of an Ohio physician who brought home for microscopic examination a portion of the throat membrane of a diphtheria victim, and permitted his children to look at it under a glass cover. Shortly after his entire family was stricken with diphtheria, and since two of the children and himself have died. Five children are yet down with the disease and are in a critical condition.—*The Sanitarian.* It will be hard to convince the intelligent microscopist that the bit of membrane under the cover-glass was the cause of this sad event.

PROF. TOMMASI-CRUDELI considers it impossible for a man to have malaria without the presence of the malarial ferment in his body (*Bacillus malariæ*).

DR. STERNBERG concluded that the inoculation of yellow-fever germs, as practiced in Rio de Janeiro and Vera Cruz, is without scientific value.

AN English chemist gives as the common articles used in the adulterations of pepper, long pepper (*Chavica Roxburghii*), rice, spent ginger, pepperette, olive stones. Under the polariscope the latter cells appear of a light bluish color.

THE business card of an agent, recently in Detroit, announces that he is "special agent and importer of the celebrated compounded physicians' pocket lens."

IN his paper, "A List of the Fresh-Water Rizopoda of New South Wales," Mr. T. Whitelegge says: "When gathering aquatic plants in search of any of the unattached forms of microscopic life, they should never be lifted entirely out of the water, but floated or pushed into a bottle with as little disturbance as possible. By adopting this method many more living forms will be obtained than would be the case if the plants were lifted altogether out of water. Directions are also given for preparing and mounting rotifers, infusoria, diatoms, desmids, etc., using one per cent. osmic acid.—*Journ. Linn. Soc., N. S. Wales.*

THE last number of the *Journal of the Trenton Natural History Society* contains a paper by Dr. Alfred C. Stokes on "A Preliminary Contribution Toward a History of the Fresh-Water Infusoria of the United States." As this preliminary article contains some 274 closely printed pages, we expect soon to see Dr. Stokes out with a work on the infusoria.

CORRESPONDENCE AND QUERIES.

CHATTANOOGA, TENN.

Editors of the Microscope:

Ever since the appearance of your May issue, I have been intending to reply to your very remarkable *manifesto* against thin sections, and thus try, as far as my experience goes in microscopical work, to show your error and combat its pernicious influence; but, until now, have not had the favorable time to express my thoughts in writing.

After this expression of my opinion of your editorial leader on the relative value of thin and thick sections, you may readily imagine my surprise—indeed, regret—on reading in your June number, Prof. Stowell's unqualified approval of your statements; for, like yourself, he is "a man, free born, of lawful age, and well recommended" by the brethren whose skilled labors have greatly aided and advanced the measure of microscopical knowledge in this country.

With each step nearer and nearer perfection of the microtome, has the greater power, usefulness and value of the microscope been demonstrated; and your demurrer to its greatest triumph—thin, even sections—is all the more untenable because you have failed to state the whole case, embracing these important facts:

1st. Without a properly prepared specimen and a harmonious *technique* from the moment the fresh material or tissue is first put into the hardening agent and subsequently carried through the various processes of clearing up, imbedding, cutting, staining, etc., to the finished mount, neither good lenses, fine substage accessories, the best light from the sky, nor the lamp can produce, will give a clear field and satisfactory results.

2d. The proper thickness of the section is a matter, I think, to be wholly determined by the particular character of the tissue, or object to be examined and studied. Of course, no one having any correct knowledge of tissue structure would think of attempting to cut a section of bone, or of the skin of the heel, to the same measure of thinness that would be necessary to demonstrate bacilli in a section of tuberculous lung? Take, for example, the section of lung tissue I sent you not long ago, and which you so flatteringly acknowledged in the same issue of THE MICROSCOPE that gave forth, without qualification, your fulmination against thin sections, and what would have been its value if it had been cut much thicker? To me it would have been entirely worthless.

If coarse details only are required, then a thick section prop-

erly cleared, and a low power objective, will answer the purpose in view; but when the finest possible details of a histological or pathological specimen are sought by the aid of a high-power objective, a section just thick enough to hold the tissue elements together will not be too thin,—the thinner the better, provided the section has been handled from beginning to end in the highest style of the beautiful art. In other words: a very thin, evenly cut section—the one three-thousandth of an inch—is of no more use or value than a section the one-fiftieth of an inch thick if it, the thinner section, has not been perfectly cleared up and well mounted; and here, perhaps, may have been the cause of your failure to appreciate "the large number of mounts kindly sent" you by your subscribers? I, myself, have received many worthless specimens; never too thin, but either too thick or badly cleared, often both; and they soon went into turpentine to be cleaned for what the glass slips were worth.

Prof. Stowell says: "With the modern microtomes, it cannot be regarded as any great skill to cut these fancy sections; while it does take a fair amount of technical knowledge to properly interpret what is in the field."

I think I know something about section cutting with first-class microtomes, having used with entire satisfaction both the Bausch & Lomb and Ryder machines; but I made many discouraging mislicks, and wasted a good deal of patient labor and cast-material before I learned to cut "fancy sections."

The proposition that it is the better knowledge to be able to "interpret what is in the field" admits of no denial; but I submit that while some persons excel in cutting and mounting, others in reading the field which has been prepared for them, it is the combination of fine *technique* with ability to see and interpret which gives the highest accomplishment in microscopical science. In no other department of science, perhaps, does the old adage apply with greater force—"a little knowledge is a dangerous thing."

There is no short road even to ordinary skill in microscopy; and if this be true, what of the years of patient steps required to reach the highest *technique* and best knowledge on the subject? In the hands of an expert operator with the microtome, the cutting of thick, medium, or extremely thin sections, is simply a matter of choice. If all the necessary conditions have been made present, namely: a perfect cast, a sharp knife, and a steady hand, the one is as easily cut as the other.

Evidently, Friedländer, when he wrote the words you have quoted from his little book, was not familiar with the best methods

of interstitial imbedding and fixing the section immediately on the slide; for he makes the point against thin sections that they are manipulated with difficulty, and there is loss of time *in spreading them on the slide* (italics my own); hence, it is not surprising that the cell-elements could not be preserved, and the object of the examination secured.

Elsewhere, * I have attempted to tell, in as precise language as I could express, the successive steps, as I am in the habit of employing them, of hardening, imbedding, cutting, staining and mounting tissues; but am none the less sensible of my failure to impart all the knowledge which experience has given me. Language, however simple and precise, cannot convey technical skill in microscopy any more successfully than it can tell the difference between your voice and my own. The *how* must be seen to be learned without stumbling and many discouragements; and hence, I should be willing to promise the gift of more knowledge in a few hours' time to the student at my work-table, than I could impart by writing in as many days.

Impressed with this truth, I begged the American Society of Microscopists at the Pittsburg meeting, last year, to adopt a rule appropriating a part of each day for a working demonstration, and henceforth, I trust there will be greater interest in the meetings and better progress in practical work, for it is safe to say that seven-tenths of all those who respond to the annual convocation attend the meeting for the special purpose of learning something of the how to work—not to spend three days and a half out of the four in listening to the reading of cold facts which will *keep*, like good wine, in all sorts of weather and may be better studied in the volume of transactions than understood on the floor of the general sessions.

Presuming upon the origin of the new rule establishing a daily working session, and in view of the fact that its usefulness, soon to be put to practical test at the Columbus meeting, may miscarry from a failure to select the best method of putting it into operation, I offer the following gratuitous suggestions:

First.—But one thing or subject at a time, and a special demonstrator appointed for each department. For example, the first hour should be occupied in showing the best methods of preparing objects and materials for the microtome. This will include the processes of hardening and imbedding different tissues. To make the lesson profitable in the highest degree, the fresh specimen

* How to work with the Bausch & Lomb microtome.

should be commenced with and run through to the perfect cast ready for the microtome. This, of course, cannot be done with the same piece of tissue in the short space of time allotted; but in view of the occasion, the demonstrator can exhibit the process at different stages by having a specimen of each already prepared. Not only the hardening agents, imbedding and other material employed should be shown by sample, but also all necessary apparatus exhibited and the manner of manipulating it successfully.

The next hour should be employed in showing how to work with the microtome—how to cut thick, medium and "fancy sections" (?); how to clear, stain and mount them in the best style. Samples of the necessary reagents should be exhibited and formula of the same given; and so on until the whole ground has been covered.

Second.—Free discussion. The last hour of each day's working session should be devoted to questioning the different methods which have been shown, and comparing opinions; and it should be the duty of each demonstrator to furnish the secretary with a complete record of the proceedings of his hour, including a list of the exhibits.

Third.—Exhibitors of microscopes and microscopic accessories and materials should *have a chance*, and to accommodate their interests, as well as satisfy the curiosity of the members in attendance, a special hour each day should be given, with the distinct understanding that during the meetings of the Society they are to shut up shop. In that way only can distraction be avoided.

Finally, as specimens of thin sections and good fields, I have the pleasure of sending you herewith three slides, two of which will, I think, specially interest you because of your studies in embryology. One shows a vertical section of, probably, a ten weeks' human embryo; and, from the same subject, another showing the decidua and chorion with the space between these membranes greatly thickened by a partially organized blood clot; also, under the same covering glass, section of the membranes involving the umbilical cord and a placental tuft. The remaining slide shows section of a papilloma of the ovary.

What ought such sections show that they do not show? Please submit them to the severest tests and report to your readers.

JAMES E. REEVES.

201 McCALLIE AVE.

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ORIGINAL COMMUNICATIONS.

FORM, ENDINGS AND RELATIONS OF STRIATED, MUSCULAR FIBERS IN THE MUSCLES OF MINUTE ANIMALS (MOUSE, SHREW, BAT AND ENGLISH SPARROW.)*

[TWO PLATES.]

SUSANNA PHELPS GAGE, PH. B.

PART II.

THE question of the form of muscular fibers is comparatively easy to solve. Their relations present a much more difficult problem.

11. ARRANGEMENT AND CONNECTION OF FIBERS.—In Sec. 1–6, Part I, and Figs. 1–9, Pl. VIII, an idea is given of the general arrangement of fibers with reference to each other in the ordinary muscles. In the study of serial sections and dissected preparations, it is seen that fibers from the opposite tendons lap to a greater or less extent, and are applied closely to each other.

In the *biceps femoris** of the mouse, a small fascicule of five fibers was traced through a large number of serial sections, when at about the middle of the muscle, three fibers of small diameter appeared and gradually increased in size, the original five gradually becoming smaller, disappeared, leaving only the three fibers which now were of full size and continued toward the opposite tendon.

* The name *vastus externus*, occuring in Part I, should be replaced by *biceps femoris*, as the muscle in question seems to agree more closely with the *biceps femoris* of the rabbit than with the *vastus externus* of man. See Krause's Anatomie des Kaninchens.

Similar cases were found in other fascicules, showing clearly how fibers interdigitate (Figs. 19–22).*

Dissected preparations show similar facts which have been already mentioned, especially in Sec. 4, *a* and *b*. They also show the following special relations: Intramuscular ends were frequently found in juxtaposition to fibers of full size (Figs. 35–36), and occasionally two tapering, intramuscular ends of fibers from the same or opposite tendons were found closely connected (Figs. 37–38). The nature of the connection and whether effected by a cell cement or some other means was not determined. In many cases intramuscular ends were entirely free from other fibers, especially in the sparrow, in which few cases were found of closely adhering ends, and the question must be raised whether the above mentioned connection would not also have disappeared with further action of the reagent. At least it was found that caustic potash dissolved the connections much more completely than nitric acid.

Striated, tapering ends, which may also be called intramuscular, were found in the œsophagus of the mouse and bat, surrounded by and closely connected with unstriated fibers (Fig. 46), as previously described for the larger animals.

The methods of preparation used were not favorable to the study of the relations of tendinous ends to other parts, but in some of the polygastric muscles, the narrow raphes connecting the sections of the muscle were not dissolved, thus leaving the tendinous ends in their natural relations. They are generally irregularly truncate, and come very near together, end to end, one large end frequently being opposite a number of small ones (Fig. 47).

12. ANASTOMOSES.—Besides the connection of intramuscular ends with other fibers, mentioned in the last section, it was found that in the mouse the connection is occasionally still more intimate, true anastomoses taking place between fibers. Transitional forms between the two extremes were found. Figs. 37–44 may be considered as a series, showing the degrees of attachment between fibers; in Figs. 37–38 the fibers are simply in juxtaposition; in Fig. 39 three are fine processes on circumscribed parts, *mm*, of each fiber, which apparently dovetail together, the union between the fibers being close; in Fig. 40 the uniting branches are long and continuous, but have longitudinal clefts, as at *mm*; in Fig. 41 the clefts may be considered as much more marked, separating several small branches from each other; in Figs. 42–44 the

*Figs. 1-34 are found in Pl. VIII–X, of Part I.

anastomosis is perfect. The appearance of continuity in the succession of the striæ to one another is one of the best means found of determining the fact of anastomosis. This is only imperfectly shown in the figures.

Anastomoses were found in specimens dissociated either by caustic potash or nitric acid, from the *pectoralis, latissimus* and *biceps femoris*, taken from three house mice and a field mouse. The form of the anastomoses is various, the two fibers being sometimes connected by one branch (Fig. 44), sometimes by a number of branches (Fig. 41). The connecting branches are sometimes large (Fig. 40), sometimes small (Fig. 42), and vary in in length from 10–100 μ., and sometimes, when dissociation has not gone too far, they are seen to pass over an intermediate fiber (Fig. 43).

In some cases the anastomosis is formed by the tip of one of the fibers (Fig. 41); in others simply by a connecting branch from a tapering end (Fig. 44). In either case, if the other fiber can be traced, it is found soon to begin to taper and come to an end, generally having branches along the side. The tip of such branches generally has the fringed appearance seen in Fig. 12. Whether this is the result of a rupture or of a simple separation of fibers connected as in Fig. 39, is not known.

It does not seem unreasonable to suppose that, as branches are given off from all parts of the circumference of a fiber (Fig. 13), there may be a union more or less intimate of one fiber with several of those nearest it. In three cases it was found that one fiber anastomosed with two others (Fig. 45), and in the middle of the *biceps femoris* of one mouse, where the fibers were in their natural relation, but were particularly transparent, the appearance was of a network of anastomosing fibers.

These anastomoses were always found in that part of the muscle where tapering ends are in greatest abundance, that is, within the middle third of the muscle.

Anastomoses of striated muscular fibers have been previously found to occur in the alimentary canal of invertebrates, in the iris of birds, the ocular muscles of the sheep, and between two branches of the same fiber in a trunk muscle of the horse.

No special investigation was undertaken to determine the character of the sarcolemma or the striations or the relations of the nuclei, but many of the prepared specimens gave appearances which may be worthy of record.

13. SARCOLEMMA.—In a few cases a marked corrugation of the sarcolemma was seen (Fig. 52), and when focusing on the edge of the fiber the appearance was presented of a process extending from the bottom of each corrugation toward the sarcous substance, and joining the narrow, dark stria in the light disc of the fiber. This appearance is often seen in insect muscle.

In all the animals examined, instances were found where the sarcolemma appeared to extend as a tube beyond the sarcous substance at both the tendinous and intramuscular end of the fibers. This tubular appearance is as marked at the ends as when, in the middle of a fiber, the sarcous substance is torn and retracted, leaving the sarcolemma to bridge the interval (Fig. 44). In a few fine tapering ends from the tongue (Fig. 48), œsophagus (Fig. 46) and skin of the mouse and bat, and also in a few intramuscular ends from the trunk or limbs this appearance was seen, the striations gradually became fainter and disappeared, while the sarcous substance itself, which in the body of the fiber has a distinct color, gradually disappears, or at least loses its color, within the prolongation of the sarcolemma. In some cases, on tapering intramuscular ends or the blunt ends from the tongue and œsophagus, the sarcolemma apparently gives off filiform or sometimes nearly spherical processes in which the sarcous substance, if present at all, is not striated (Figs. 3, 11 and 27). At the tendinous end of fibers from many muscles, from all the animals examined, and prepared by nitric acid or caustic potash, especially when the end is somewhat truncate, the tubular prolongation of the sarcolemma seemed very clear, the end of the sarcous substance within it always having a delicately fringed appearance (Figs. 50–51). Tendinous ends seen *in situ*, as in the *rectus abdominis* (Fig. 47), give the same impression. In caustic potash preparations the tubular prolongation is less frequent, but a sharp line is often seen encircling the end of the fiber, as though the sarcolemma at this point had been torn, leaving the fringed sarcous substance extending a trifle beyond it. The divisions into which some tendinous ends break up (Fig. 6 and Pl. X), and the branches of intramuscular ends (Figs. 12–13), do not give the impression of being bounded by a definite membrane at their tips as at their borders, but seem to cease in an indefinite way, generally in the form of a fringe.

14. NUCLEI.—In general the nuclei are more numerous in proportion to the volume of the fiber at both the tendinous and

intramuscular ends (Figs. 1 and 4) than in the body of the fiber. They frequently are irregularly placed, but sometimes form distinct rows (Figs. 1 and 23). In the latter case many of the nuclei are elongated, and some show signs of division. Nuclei also occur in clusters (Fig. 31) resembling the end-plates figured by Krause, but in the tongue and œsophagus of bat and mouse fibers were found on which several such clusters occur, while Krause thinks there is only one end-plate to each fiber. A nucleus was always found near the tip of an intramuscular end, and generally one at the angle where a branch is given off. In caustic potash preparations the nuclei are much more distinct than in nitric acid preparations, unless the latter are stained. (See methods.)

15. STRIATIONS.—At the tapering end of a fiber the striations generally become less marked, and beyond the last nucleus they are sometimes clear (Figs. 2 and 14), sometimes indistinct (Fig. 4), and sometimes there is simply a granular appearance (Figs. 7 and 11). When the tendinous ends break up into processes the striation becomes less marked, and in the fine fringed processes of tendinous ends and intramuscular branches (Sec. 13) ceases altogether.

16. FASCICULES.—In studying serial sections of a portion of the *biceps femoris* of the mouse it was found that the fascicles, though changing greatly in shape as seen in Figs. 53–55, continued from tendon to tendon as usually described; but both the secondary fascicles, as shown by the fine lines in the same figures, and the tertiary fascicles, or *fascicules*, as shown in Figs. 56–69, are neither constant in shape, nor in position in the fascicle, nor do they extend in their integrity from tendon to tendon. In tracing from section to section it is seen that a fascicule becomes divided by septa into two or more; these may be permanent or may disappear and others appear, and that two fascicules at first separate may unite. The figures show these changes more clearly than can a description, while the gradual transition between two forms can be only seen by close study of the sections themselves. The fibers composing one of these fascicules are shown in Figs. 19–21.

This subject of fascicules has not been investigated as fully as is desirable; its special importance seems to be in connection with the determination of some of the relations of fibers to each other, which can only be finally settled by examining serial sections.

17. METHODS.—All important or doubtful points in connection with this investigation were tested by at least two methods:

a. Fresh muscle was dissected with needles in blood serum only for the purpose of measuring the diameter of fibers.

b. Dissociation in nitric acid. In order to get good results it was found necessary to put the specimen into the reagent directly after death and the removal of the skin. A twenty per cent. solution of nitric acid (conc. nitric acid 20 cc., water 80 cc.) softens the connective tissue, the time necessary varying with the temperature, being 24 h. if below 18° C., and 1 h. if 40–50° C. Above 40° C. frequent examination is necessary to avoid too great disintegration. The acid is removed by placing the specimen in water for one-half to 24 h. A few fascicles of a muscle are placed on a slide, in glycerine containing picric acid or picro-carmine which gives a general stain, and gently dissected with coarse needles; the excess of glycerine is removed; a drop of warm glycerine jelly is allowed to spread slowly over the preparation; the fibers are arranged with the needles so as to lie as straight as possible; the slide is cooled until the jelly has a glutinous consistency and then is covered by a warm cover or one thinly coated with warm glycerine jelly. In this way the fibers retain their places on the slide.

If the specimen was put into the acid *in toto*, so that the muscles were held naturally extended, only a slight shrinkage took place in their length, but if a detached muscle was put into the acid a shrinkage of one-third its length was observed. In both cases the dissected fibers were somewhat longer than the shrunken muscle from which they were taken, probably owing to the fact that the connective tissue shrinks more than the fibers, and draws the ends of the muscle together.

It was found possible to stain the nuclei after dissociation in the acid if, after thoroughly removing the acid by water, the muscle was placed 12 h. in Koch's dilute, red, tubercle stain. After staining, a few fascicles are placed on a slide with 20 per cent. alcohol and a drop of picric acid to give a general stain; this was replaced by 50 per cent. alcohol and then by 95 per cent. In the last the fibers, which in the 20 per cent. alcohol are stiffened, again are flexible and easily dissected by needles. Clove-oil collodion is then placed on the specimen and partially dried to hold the fibers in position, and it is then mounted in Canada balsam. Though this stain is excellent at first, it was found that after two months some of the specimens were much faded.

Prof. Gage has recently found that by placing muscles after being freed from nitric acid by soaking in water, in a saturated aqueous solution of alum, the fibers, for some weeks at least, can be dissected as well as when first prepared. The nuclei stain well in hæmatoxylin.

c. Dissociation in caustic potash. A muscle or limb is placed as fresh as possible into 35–40 per cent. solution of caustic potash (caustic potash 35 or 40 grams, water 65 or 60 cc.) for 15–30 min., depending upon the amount of connective tissue present, when a few fascicles are removed to a slide, dissected quickly with needles and immediately covered by potassium acetate (40 grams potassium acetate to 25 cc. of water), and mounted permanently in potassium acetate or glycerine jelly. In dissociating muscles in this way, a shrinkage of at least one-fourth in length occurs.

d. For serial sections, the animal was injected from the heart with fine red mass, and the muscles prepared in the usual way for serial section in paraffine.

SUMMARY OF PART II.

In the longer muscles, which are composed chiefly of tapering fibers, those from opposite tendons interdigitate or lap by each other for some distance, and the tapering ends are applied to fibers of full size, or more rarely to tapering ends, from the same or the opposite tendon.

Anastomoses of various forms occasionally occurred near the middle of several limb muscles of the mouse, between two fibers. Previously such anastomoses, occurring in limb or trunk muscles, have only been described in the ocular muscles of the sheep.

The sarcolemma, in some cases at least, sends processes to the dark line (Krause's) in the light disc, as in insect muscle, and on many fibers it appears to be a tubular sheath extending beyond the sarcous substance proper, at both the tendinous and intramuscular end. The sarcous substance ends within this tube by minute unstriated processes.

The nuclei are irregularly placed on the fiber, or occur in rows or groups, but there is always one near the tip of an intramuscular end, and usually one near the point where a branch is given off.

GENERAL CONCLUSIONS.

In general form and arrangement the muscular fibers of these minute animals agree with those of man and the larger vertebrates.

On finding spindle-form elements in the striated muscles of the trunk, Biesiadecki and Herzig drew the conclusion that in form and relations striated muscular fibers of the trunk show resemblance to the unstriated fibers. In comparing the facts presented in this paper concerning the branched form and intimate relations of the fibers of skeletal muscles, with the known form and relations of

the muscular fibers in the heart of adult and fœtal vertebrates (see Weismann and Gage), it is seen that the differences between skeletal and cardiac muscle are not so radical as usually supposed.

The fact that anastomoses occur between fibers points to the conclusion that the physiological connection may also be as intimate as the morphological, and gives rise to the query whether each of the fibers so united has a separate connection with a nerve.

EXPLANATION OF THE PLATES.

PLATE XI.

Magnification of Figs. 35–44, 260 diameters; of Fig. 45, about 50 diameters.

Fig. 35.—A tapering intramuscular end *i*, closely adherent to the surface of a fiber of full size. From the brachium of a young English sparrow.

Fig. 36.—A tapering and branched intramuscular end *i*, closely attached to the side of a fiber at its full size. From the shoulder of a house mouse.

37.—Two tapering and branched intramuscular ends, belonging to fibers extending in the same direction, adherent to each other, one terminating .2 mm. from the tip of the other. From the *biceps femoris* of a house mouse.

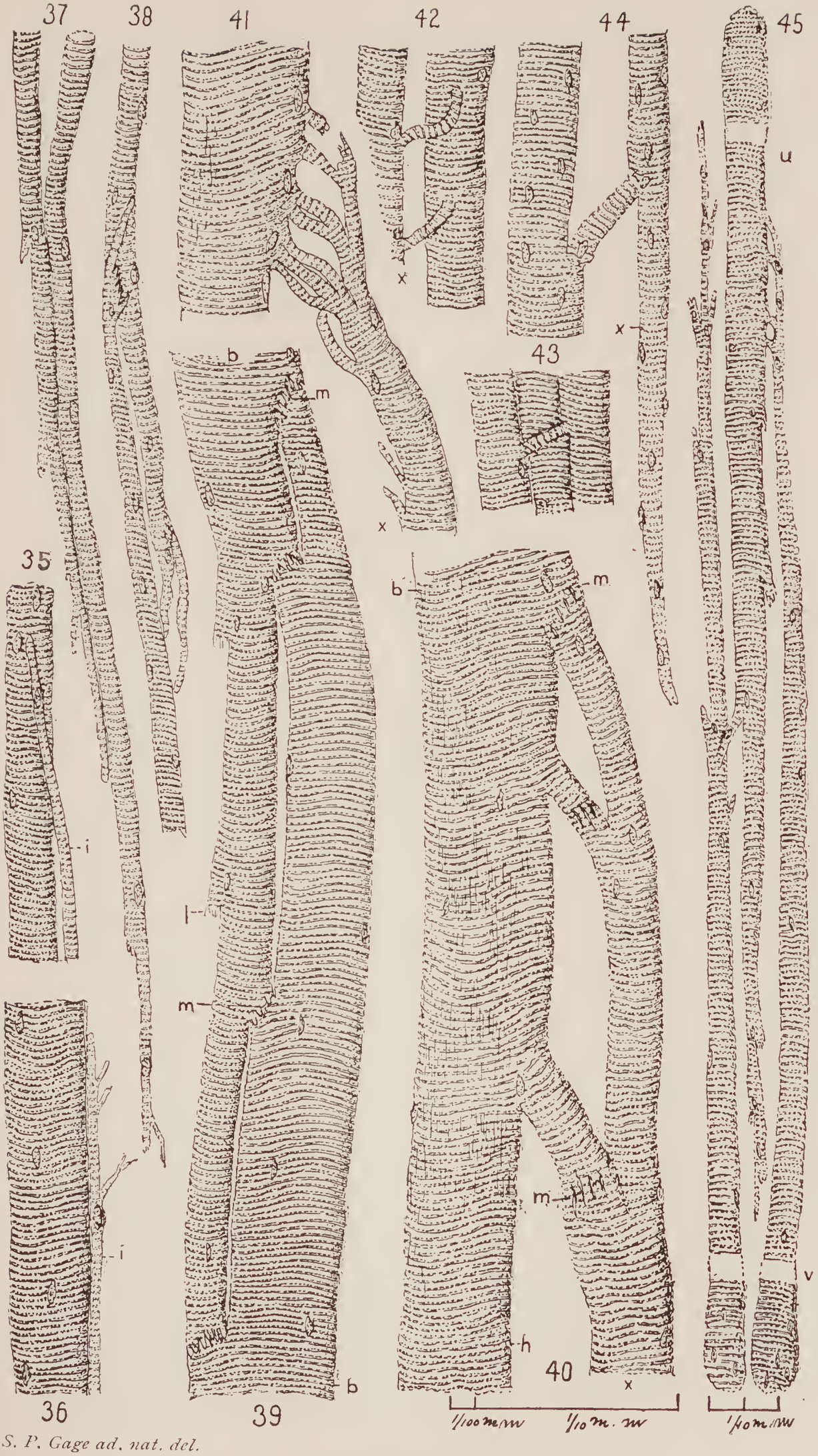
Fig. 38.—Two tapering and branched intramuscular ends, belonging to fibers extending from opposite tendons, adherent to each other and lapping for about .2 mm. From the *pectoralis* of a house mouse.

Fig. 39.—The thick tapering ends of two fibers from opposite tendons. They are closely connected at *mm*. The line of union is zigzag, as though the fine processes such as seen at *l* interdigitate. At *bb* the fibers are of full size. From near the middle of the *biceps femoris* of a house mouse.

Fig. 40.—An anastomosis of two fibers, in the connecting branches of which are seen a number of longitudinal clefts. The smaller fiber *x* comes to an end at this point, and in the specimen can be traced for some distance toward the tendon. The larger fiber has its maximum size at *b*, and from *h* it can be traced 4 mm. to its tapering, branched, intramuscular end, one of the branches forming an anastomosis with another fiber. From the *biceps femoris* of a house mouse.

Fig. 41.—An anastomosis of two fibers by a number of branches from the tip of one of them. The smaller fiber *x* in the

For general considerations, see Pl. VIII-X.



S. P. Gage ad. nat. del.

PLATE XI.

specimen has branches at intervals for 1 mm., where it becomes of full size. From the *biceps femoris* of a house mouse.

Fig. 42.—An anastomosis of two fibers, the connecting branches being seen at the side of one fiber, on the surface of the other. In the specimen the smaller fiber x continues to branch, and about 1 mm. from this point ends in a fine point. From the *biceps femoris* of a house mouse.

Fig. 43.—An anastomosis of two fibers in which the connecting branch passes over a third fiber. From the *biceps femoris* of a house mouse.

Fig. 44.—An anastomosis in which the smaller of the connected fibers x is seen to have a tapering end. From the *biceps femoris* of a house mouse, dissociated in caustic potash.

Fig. 45.—The anastomoses of one tapering fiber with two others from the opposite tendon, showing in a typical way the relations of anastomosing intramuscular ends to each other. The portion from u to v represents 3 mm., while the whole muscle is 17 mm. long. The intramuscular ends are branched and two of them, after anastomosing, end freely. From the *biceps femoris* of a house mouse.

PLATE XII.

Magnification of Figs. 46–51, 260 diameters; Fig. 52, 660 diameters; Figs. 53–55, 25 diameters; Figs. 56–69, 45 diameters.

Fig. 46.—The tapering end i of a striated fiber from the cardiac end of the œsophagus of a gray bat. It is branched and is seen *in situ*, surrounded by unstriated fibers.

Fig. 47—Tendinous ends of the *rectus abdominis*, a polygastric muscle, from a house mouse. T and t, ends of a fiber 5 mm. long. t', ends of much smaller fibers, seen in their natural relations opposite to T on the other side of the narrow tendinous raphe.

Fig. 48.—A tapering end from the tongue of a mouse, with a tubular prolongation of the sarcolemma apparently extending beyond the sarcous substance.

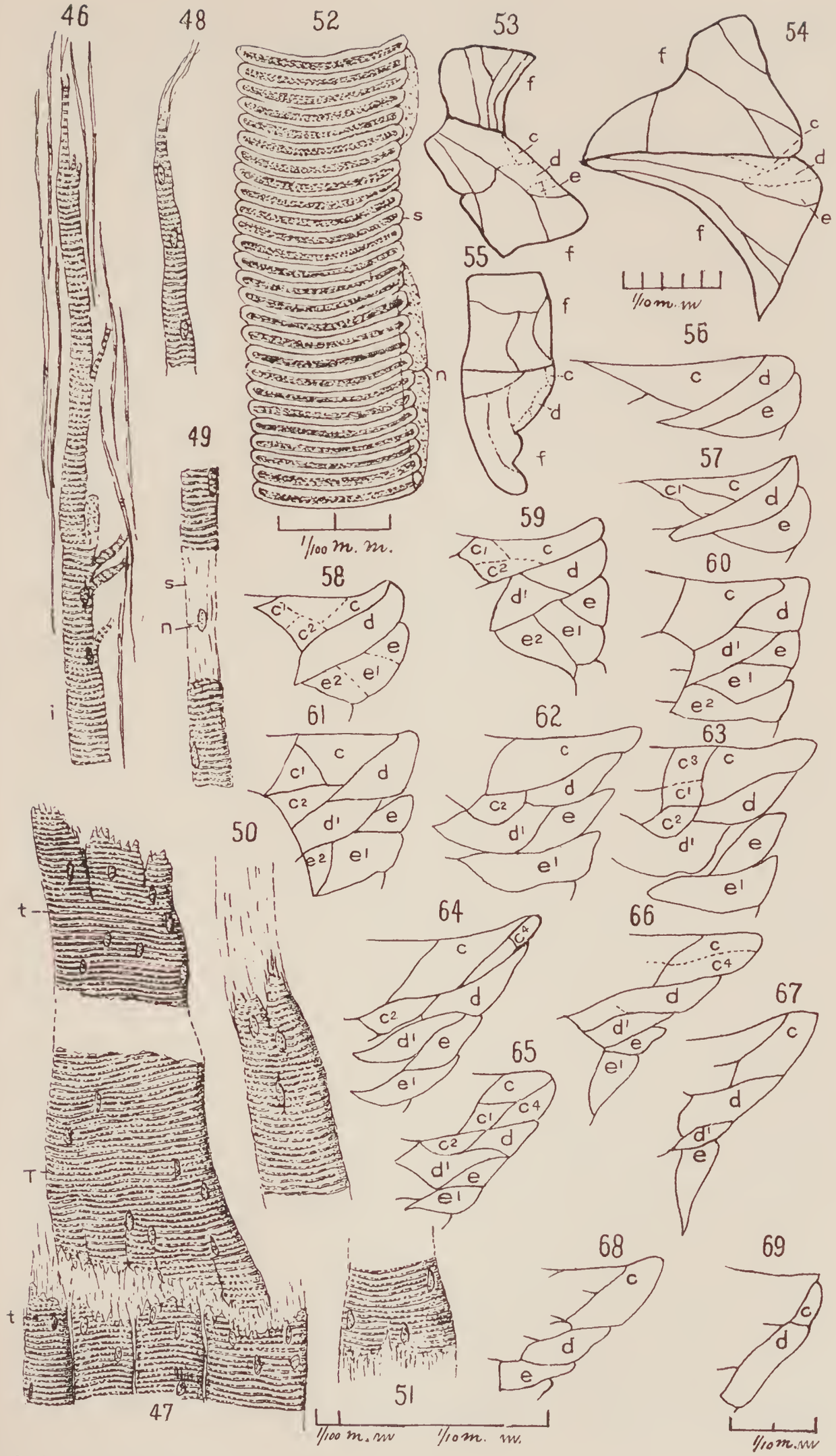
Fig. 49.—A portion of a fiber from the *latissimus* of a shrew, in which the sarcous substance has separated, the tubular sarcolemma bridging the interval. n, a nucleus on the sarcolemma.

Figs. 50 and 51.—Tendinous ends, from which extends a transparent sheath, apparently a prolongation of the sarcolemma beyond the sarcous substance, which terminates in fine fringed processes showing no sign of striation. From a short muscle of the back of a house mouse.

Fig. 52.—Part of a fiber showing a wavy contour. The bottoms of the depressions apparently join the dark striæ (Krause's lines) in the middle of the light discs. The nuclei *nn* are outside the sarcolemma, and one is dividing. From a long muscle of the inside of the leg of a gray bat. Drawn with a 2 mm. Zeiss, apochromatic, homogeneous immersion objective and ocular x4, in optical section a little below the middle of the fiber.

Figs. 53–55.—Transections selected from a series into which a small portion, consisting of two fascicles, *f*, *f*, of the *biceps femoris* of the house mouse was cut. Fig. 53 is at a point $1\frac{1}{2}$ mm. from a tendon. Fig. 54 is $3\frac{1}{2}$ mm. from the tendon. Fig. 55 is 13 mm. from the first tendon and 1 mm. from the other. The same two fascicles are seen in each figure, but differ in form and relative size. The fine lines indicate the secondary fascicles into which they are divided, and these are not constant in form, number or relative position. The dotted lines enclose a few tertiary fascicles or fascicules, *c*, *d*, *e*, of which more and enlarged sections are seen in the following figures.

Figs. 56–69.—Fourteen transections selected from the same series as Figs. 53–55, showing the same fascicules *c*, *d* and *e*, Fig. 56 corresponding to Fig. 54, Fig. 68 to Fig. 55. These consecutive figures are from points in the muscle varying from .2 to 2 mm. apart, and intermediate and transitional forms occur between them. Fig. 56.—Three distinct fascicules, which, up to this point in the muscle ($3\frac{1}{2}$ mm. from the tendon) have each been formed by the union of two or more fascicules as distinct as these. Fig. 57.—The fascicule *c* has become divided into *c* and c^1 by a septum. Fig. 58.—Two new septa appear in *c* and two in *e*, giving *e*, e^1, e^2. Fig. 59.—A septum appears in *d*, giving *d* and d^1. Fig. 60.—The septa in *c* disappear, and also the one between e^2 and a neighboring fascicule. Fig. 61.—*c* is again divided by septa, in a somewhat different manner from the first division, into *c*, c^1, c^2, and e^2 is again separate from its neighbor. Fig. 62.—*c* and c^1 unite, and also e^1 and e^2. Fig. 63.—*c* is again divided into *c*, c^1 c^3, and d^1 unites with a fascicule at the left. Fig. 64.—*c* is divided anew, in another part, into *c* and c^4 and d^1 separates from its neighbor. Fig. 65.—*c* again divides into *c* and c^1. Fig. 66.—c^1 and c^4 unite, and also *d* and c^2. From this point the fibers diminish in number, and the fascicules unite and disappear. Fig. 67.—c^1 and c^4 unite and *e* and e^1. Fig. 68.—d^1 disappears. Fig. 69.—*e* disappears. The remainder of the sections to the tendon were not perfect enough to trace the



S. P. Gage ad. nat. del.

PLATE XII.

fascicules farther. Fig. 19 is an enlarged view of *e*, Fig. 53, showing the fibers; Fig. 20 is of Fig. 54, *e*, and Fig. 56, *e*; Fig. 21 is of Fig. 57, *e*.

Fig. 55–69 drawn with one-half and three-fourths inch Bausch & Lomb objectives.

BIBLIOGRAPHY.

Brief statements are given of the special points in the articles bearing upon the present paper, and the section of this paper to which they refer is given in parenthesis.

1. *Baur, A.*—Der Bau der Chitinsehne am Kiefer der Flusskrebse und ihr Verhalten beim Schalenwechsel. Arch. für Anat. u Phys., 1860, pp. 113–144, 2 pl. The figures show the sarcolemma extending beyond the sarcous substance into the chitin. (See Sec. 13.)

2. *Beale, L. S.*—Distribution of nerves to the elementary fibers of striped muscle. Phil. Tr., London, 1860, pp. 611–619, 1 pl. Gives figures of the capillaries and nerves in the diaphragm of a white mouse, and says that most of the nuclei seen on the sarcolemma belong to blood vessels and nerves. p. 614. (Sec. 14).

3. ——— On the structure and formation of the sarcolemma of striped muscle, and the exact relation of the nerves, vessels and air-tubes (in the case of insects) to the contractile tissue of muscle. Trans. Royal Micr. Soc., 1864, pp. 94–108, 2 pl. Says sarcolemma has not been demonstrated in the eye-lids and eye-balls of the green tree-frog, nor in the heart or tongue, that is, where the fibers branch or are finely divided, nor in developing fibers. p. 95. (Sec. 13). There are fine processes connecting the sarcolemma at every point with intermuscular connective tissue, p. 100. (Sec. 11, 13).

4. ——— New observations upon the minute anatomy of the papillæ of the frog's tongue. Quart. J. Micr. Sc., 1869, pp. 1–18, 4 pl. Says the branches ($\frac{1}{2}$ μ in width) (Sec. 5) of muscular fibers end at the summit of the papillæ, there being no striation beyond the nucleus which is near the end of each branch, the striated substance following the nucleus and being formed by it. pp. 13–14. (Secs. 5, 6, 15, 14).

5. *Biesiadecki, A., u. Herzig, A.*—Die verschiedenen Formen der quergestreiften Muskelfasern. Sitzungsb. d. k. Akad. d. Wissench. Math-naturw. Cl., Wien, 1858, pp. 146–149, 3 pl. Figure cylindrical, tapering and fusiform fibers, and both tapering and branched ends from the trunk muscles of some of the larger

animals (Sec. 1, 2, 3, 7); a dichotomously divided end from a trunk muscle of the horse, the two branches of which anastomose (Sec. 12); and fibers from the frog's tongue, both ends of which are large and branched (Sec. 6); and draw the analogy on account of form between smooth and striped muscle, p. 149. (See conclusions).

6. *Bremer, L.*—Ueber die Muskelspindeln nebst Bemerkungen über Structur, Neubildung und Innervation der quergestreiften Muskelfaser. Arch. f. mikr. Anat. Bd. XXII, 1883, pp. 318–356, 2 pl. Says that in the mouse chains of nuclei are found in the spring, which develop into new muscular fibers. p. 352. (See 14).

7. *Bowman, W.*—On the minute structure and movements of voluntary muscle. Phil. Tr., Lond., 1840. pp. 457–501, 4 pl. Shows the sarcolemma of insect muscle as corrugated, with processes extending from the depressions to the sarcous substance. (Sec. 15).

8. *Busk and Huxley.*—Manual of human histology. 2 vol., illustrated. London, 1853. A translation of Kölliker's histology. Figure of a branched ending in the lip of a rat, the ends of the branches being unstriated and mingling with the fibers of the corium, p. 245, vol. I. (Sec. 8, 15).

9. *Dogiel, J.*—Ueber den Musculus dilator pupillæ bei Säugethieren, Menchen und Vögeln. Arch. f. mikr. Anat., Bd. VI, 1870, pp. 89–99, 1 pl., and Neue Untersuchungen über den pupillenerweiternden Muskel der Säugethiere und Vögel. Arch. f. mikr. Anat. Bd. XXVII, 1886, p. 403, 1 pl. Figures branches and anastomoses of striated fibers in the iris of birds. (Sec. 12).

10. *Felix, W.*—Die Länge der Muskelfaser beidem Menchen und einigen Säugethieren. Leipzig, 1887. pp. 1–9, 1 Fig. From the Festschrift für Albert von Kölliker. Finds length of fibers in man 53 to 123 mm., in other large animals 20 to 80 mm. (Sec. 4); in man and the rabbit fibers branch, and in man anastomose, p. 6–9, (Sec. 7, 12); gives a method of preparing muscles, separated from the skeleton, without shrinkage, p. 5. (Sec. 17).

11. *Fick, A.*—Ueber die Anheftung der Muskelfasern an die Sehnen. Arch. für Anat. u. Phys., 1856, pp. 425–432, 1 pl. Shows the sarcolemma extending into the tendon. (Sec. 13).

12. *Gage, S. H.*—Muscular tissue. Reference hand-book of medical sciences, Vol. V, pp. 59–74, illustrated. New York, 1887. Describes in the mouse striated fibers extending on the œsophagus to the stomach, p. 59, (Sec. 6); tapering intramuscular ends in the

mouse, and branched ends in the cat, p. 62. (Sec. 7); states that intramuscular endings are always applied to fibers of full size, p. 92, (Sec. 11); calls attention to the necessity of measuring fibers at their full size, p. 63, (Sec. 5); figures cardiac muscle from the great groups of vertebrates, pp. 66–71; thinks a stimulus might be transmitted from one lapping fiber to another, p. 72. (See conclusions).

13. *Haller.*—Elementa physiologiæ. 1757-1766. Says some fibers have fine, acute ends, Vol. IV, Sec. 1, p. 3; hence Krause gives him the credit of discovering intramuscular ends.

14. *Haycraft, J. B.*—Upon the cause of striation of voluntary muscular tissue. Quart. J. Micr. Sc. 1881, pp. 307–329, illustrated. Thinks the fiber is structureless, the cross-markings being due to its beaded form, with perhaps the exception of Dobie's (Krause's) line, which occurs at the narrow part (Sec. 13), and shows the different appearances due to change of focus of the microscope, pp. 315, 327. (See Fig. 52).

15. *Heitzmann, C.*—Microscopical morphology of the animal body, pp. 849. Illustrated. New York, 1883. Says the sarcolemma is a structureless, corrugated membrane, without nuclei, passing around the end of the muscular fiber, which is joined to the tendon connective tissue, p 267. (Sec. 13.)

16. *Herzig, A.*—Ueber spindelförmige Elemente quergestreifter Muskelfasern, Sitzungsb. d. k. Akad. d. Wissench. Math-naturw. Cl. Wien, Bd. XXX, 1858, pp. 73–74. First found spindle-form fibers in muscles of the cow and sheep. (Sec. 3.)

17. *Jousset et Bellesme.*—Sur les anastomoses des fibres musculaires striées chez les invertébrés. Compt.-rend. Acad. d. Sc. Par. T. XCV, 1882, p. 1003–4. Find fibers anastomose in the digestive tube of larval insects and the gastric appendages of crustacea, where they tend to produce simultaneous movement. (Sec. 12 and conclusions.)

18. *Kölliker, A.*—Handbuch der Gewebelehre des Menschen, pp. 749. Illustrated. Leipzig, 1867. In the middle of the longer muscles the fibers are spindle-form, and at the ends are tapering, p. 159. (Secs. 1–3 and 11.) Thinks fully formed fibers may divide into two or more by longitudinal clefts, p. 178. (Sec. 10.) In developing muscle, nuclei occur in rows and groups, p. 176. (Sec. 14.)

19. *Krause, W.*—Die motorischen Endplatten der quergestreiften Muskelfasern. Hannover, 1869. pp. 192. Illustrated. A

collection of papers, mostly from periodicals. Says that fibers, apparently longer than 40 mm., are really composed of two spindle-form elements, p. 4. In short muscles and in the longest muscles of small animals, the fibers are as long as the muscle, p. 5. (Sec. 1–4.) A fiber has only one end-plate, p. 79, and end-plates are easy to examine in the diaphragm of the mouse, p. 88. (Sec. 14.) The sarcolemma extends around the fine pointed end of fibers, p. 4. (Sec. 13.)

20. *Lawdowski.* — Militarärzlichen Jour., 1884 and 1885, Abstract in Jahresb. ü. d. Fortschr. d. Anat. u. Physiol., 1885, p. 496. Says in rat and mouse the fibrillæ go over directly into tendon. (Sec. 13.)

21. *Margo, T.*—Neue Untersuchungen über die Entwickelung, das Wachsthum, die Neubildung und den feineren Bau der Muskelfasern ; Wien, 1861. pp. 74, 5 pl., from Sitzungsb. d. k. Akad. d. Wissench, Math-naturw. Cl. Wien. Bd. XX. Shows a branched ending from the intestine of an insect (Sec. 8), and makes the generalization that branches and anastomoses result from the incomplete joining of the sarcoplasts or elements from which the fibers arise, p. 37. (Secs. 7, 8 and 12.)

22. *Milne-Edwards.*—Leçons sur la physiologie et l' anatomie comparée de l' homme et des animaux. Paris, 1857–1879. T. X, pp. 447 and 451, Bibliography of Muscle.

23. *Pearson, L.*—The muscular coats of the œsophagus of the domesticated animals. Unpublished thesis. Shows the arrangement of the fibers in bundles which interdigitate and cross on the ventral and dorsal line (Sec. 6), and also tapering fibers with pointed, blunt or branched ends. (Sec. 7, 8.)

24. *Powwyssozki, W.*—Ueber die Beziehungen der quergestreiften Muskeln zum Papillärkörper der Lippenhaut. Arch. für mikr. Anat., Bd. XXX, 1887, pp. 327–335, 1 pl. Shows branched endings, each branch being formed by a fibril, which gradually merges into a tendon attachiug to the basal membrane of the *stratum mucosum.* (Sec. 8, 13.)

25. *Ranvier, L.*—Leçons, d' Anatomie générale sur le septème musculaire. Paris, 1880. The striated muscular fibers of the lymph-hearts of the frog branch, p. 336. (Sec. 7.)

26. *Rollett, A.*—Sitzungsb. d. k. Akad. d. Wissench. Math-naturw. Cl. Wien. Bd. XXXI, 1856, heft 1 und 11, pp. 176–180, 1 pl. Found tapering intramuscular ends in the cow, calf, frog, carp, rabbit and man (Sec. 7), but as far as traced, these tapering

fibers remained small; hence concludes that they are developing fibers which have not yet reached from tendon to tendon, p. 179. (Sec. 5.)

27. *Rouget, C.*—Terminaison des nerfs moteurs dans les muscles chez les reptiles, les oiseaux et les mammifers. J. de la physiol. de l' homme, Par. T. V, 1862, pp. 574–593, 2 pl. Represents the outline of fibers by a wavy line, in reptiles, birds, rabbit, cat and man. (Sec. 13.)

28. *Tergast, P.*—Ueber das Verhaltniss von Nerve und Muskel, Arch. für mikr. Anat. Bd. IX, 1873, pp. 36–46, 1 pl. Figures striated branches and anastomoses of fibers in the ocular muscles of the sheep, which closely resemble the drawings of mouse muscle accompanying this article. (Sec. 7, 12.)

29. *Thanhoffer, L. v.*—Beiträge zur Histologie und Nervenendigung der quergestreiften Muskelfasern. Arch. für mikr. Anat. Bd. XXI, 1882, pp. 26–44, 2 pl. Says sarcolemma has two layers, the outer with few nuclei unites with the tendon, the inner has many nuclei and contains Krause's lines; the numerous nuclei at the end of a fiber are simply indications of lymph spaces, p. 42. (Sec. 13, 14).

30. *Thin, G.*—A contribution to the anatomy of connective tissue, nerve and muscle, with special reference to their connection with the lymphatic system. Proc. Roy. Soc., Lond., 1874, pp. 515–531, 3 pl. Figures lymphatics of mouse muscle, and thinks the nuclei of the sarcolemma belong to the lymphatic system. (Sec. 14).

31. *Verson, E.*—Zur Insertionweise der Muskelfasern. Sitzungsb. d. k. Akad. d. Wissench., Math-naturw, Cl., Wien, Bd. LVII, 1868, pp. 63–66, 1 pl. Shows sarcolemma going over into tendon. (Sec. 13).

32. *Weber, E. H.*—Funke's Lehrbuch der Physiologie, Bd. I, 1858, p. 649. Says muscle fibers may be pointed, rounded or divided at both ends. (Sec. 7, 8).

33. *Weismann, A.*—Musculatur des Herzens. Arch. f. Anat. Physiol. u. wissench. Med., 1861, pp. 41–63. 3 pl. Believes difference in form of fibers does not affect the function nor quickness of action, in the heart the form being that which gives greatest strength; gives a series of figures showing heart muscle in different animals and in different stages of development. (See Conclusions).

34. ——— Zur Histologie der Muskeln. Ztschr. f. rat. Med. Bd. XXIII, 1865, pp. 26–45. Says he first used caustic potash to demonstrate the sarcolemma around the tendinous end of a fiber. (Sec. 13).

35. *Winkler, F. N.*—Beiträge zur Kentniss der Herzmusculatur. Arch. f. Anat. u. Physiol., 1865; pp. 261-300, 2 pl. Shows anastomoses of muscular fibers in the heart.

Nearly all of these articles contain more or less complete bibliographies of the form and structure of muscular tissue, those in Krause, Kölliker and Milne-Edwards being especially good.

ON PREPARING LARGE SECTIONS OF LUNG.

G. S. WOODHEAD, M. D.

(Communicated by V. A. Latham, F. R. M. S.)

THIS is particularly good for demonstrating the localization of tubercular and other lesions in such organs as the lungs in Phthisis, etc. Make the first incision through the lung in the direction in which you wish to have your sections, usually from apex to base and from the antero-external angle of the lung down to the root. A second incision is made parallel to the first, so that a thin slice, not more than half an inch in thickness is obtained. Harden this carefully for 5 or 6 weeks in Müller's fluid. The hardening must be as perfect as possible if even moderate success is to be attained. The best way to accomplish this is to lay the section out flat in a dish on a layer of lint, then cover with several layers of lint, and immerse the whole in Müller's fluid, a plate of glass or weighted wood being used to keep it down. Spirit also hardens the sections well, and in some cases this may be used, but remember that it is difficult to get rid of the whole of the spirit without softening the textures too much; especially is this the case in warm weather; but it may be done by running a continuous stream of water over the sections for about 36 hours before further preparation. The sections hardened in Müller's fluid need not be washed with water for more than 24 hours. Then place the slice of tissue in a mixture of 5 parts of mucilage (B. P.) and four parts of a syrup made by boiling 20 oz. of sugar in a pint of water. The proportion may be varied a little in winter by using only three parts of the syrup. Two drops of carbolic acid to the ounce may be added to prevent the formation of fungi. The tissue should be soaked in this for 48 hours at least, but may be left for a fortnight, or even a month, without injury. The microtome used is one modified by Dr. Alexander Bruce, in which are combined the best features both of the Hamilton and Williams microtomes. It is made by Mr. Alexander Fraser, 7 Lothian Street, Edinburgh, Scotland. The section is taken from the gum

and syrup, carefully dried with a soft, clean cloth; then placed in B. P. mucilage, until the surface is thoroughly saturated, (ten minutes is quite sufficient for this), after which it is transferred to the freezing plate, on which a very thin layer of gum has been laid. The section becomes fixed immediately. It must then from time to time be carefully banked up with gum, the tin freezing box being placed over it during the intervals. When nearly frozen, take a long thin knife and pare the tissue down to the level of the rails. Now prepare a large, clean, white, flat dish, fill with slightly warm distilled water, to which a little syrup may be added (specially if the tissue is at all brittle) and place it in front of the tub, about an inch below the level of the sections, so as just to clear the plane. In this lay the sheet of glass which is to serve as the cover-glass. This should be considerably larger than the section. The glass, I find, best suited for the purpose is thin rolled plate, which is to be obtained only from Messrs. Chance, Birmingham, Eng. Take the first complete section, if thin enough, spread out with the aid of a camel-hair pencil on the glass, on which it is carefully removed from the water and transferred to a second vessel containing distilled water, where it is allowed to stand for a few hours in order that all the mucilage and sugar may be thoroughly washed out. The sections may be mounted either as they are, unstained, or they may be stained with alum-carmine, picro-carmine, or ordinary ammonia-carmine; but the two former are, in my opinion, the best.

In staining with picro-carmine, a rapid staining on the slide, with no after-washing except around the section, is best. For the alum-carmine staining, the best method is to transfer the cover-glass with its section to the staining fluid, where it may be left for a night. It is then put back into distilled water, and is there thoroughly washed in order that all alum crystals may be removed. In order to clear up some of the unstained sections, Hamilton's liquor potassæ method may be used. After the sections have been thoroughly washed, he pours over the surface with a pipette a strong solution of liquor potassæ and water. Strength of 1–4 gives the best results. When thoroughly cleared up, the section may be mounted. To imbed and mount, take a quantity of gelatin (Nelson's or Cox & Coignet's), wash well and cover with a saturated and filtered solution of salicylic acid. Allow it to soak all night, so that a considerable quantity of water may be absorbed. Pour off superfluous water and heat over a water-bath until the whole is thoroughly melted. Add one part by measure of this to two parts of glycerin; heat over a water-bath, stirring

regularly until the whole is thoroughly mixed; strain through a piece of close, clean flannel into a flask, in which it may be re-heated over the water-bath as required. When not in use the flask should be kept well corked. Having allowed most of the water to drain away from the section by filtering, with the glass protecting the section from dust (it must not be allowed to dry or air bubbles will be enclosed in the section and it will be spoiled), it is placed, section upwards, on a level stand (a screw tripod serves the purpose admirably), and a thin layer of the warm glycerine jelly is run gently over the surface of the section by means of a pipette. Great care must be taken not to allow the jelly to run too rapidly, or the margins, or even the whole section, may be displaced. It is then set aside to cool, after which, if kept away from dust and heat, it may be left for a week or two until time and effort be found to finish it off. This finishing-off process requires a little practice, but it is not difficult. The slide on which the section is to be mounted is placed on three or four pieces of cork over a water-bath until it is warmed through. This is to prevent the too rapid setting of the jelly. It is then transferred to the tripod, and a quantity of jelly is poured onto the center and gradually onto the end nearer the manipulator. The cover-glass is then taken and gently lowered, the near end first, and so gradually down onto slide.

The jelly on the cover keeps the section in position sufficiently long to allow of the cover-glass coming into its place. The slide usually retains sufficient heat to melt away all superfluous jelly. Should this not be the case, the whole slide may be again heated over the water-bath, and by the application of gentle pressure, the extra mounting medium is squeezed out. If this surplus medium be left at the margin of the cover, the slide may be left for some time without further treatment. To preserve the specimen, remove the extra jelly with a spatula or knife, wipe carefully, first with a moist, then with a dry cloth. Then paint the margin of the cover-glass and the slide with benzol balsam, layer after layer being applied at intervals of two or three days, until there is a good firm coating. Unless this be done at once after clearing off the extra jelly, the jelly at the margin under the cover dries rapidly, air-bubbles getting under the cover and spoiling the section. I have found that it is good to mount these in common wooden frames like slate frames, so that the cement may be examined from time to time, and, if necessary, repaired. The sections are now ready for examination. Specimens of normal lung, (1) uninjected; (2) injected with carmine gelatin; (3) sections of emphysematous lung uninjected: (4) injected with Prus-

sian blue to show the normal structure and arrangement of the blood-vessels, alveoli and air passages, to the altered conditions in emphysema; (5) miliary tuberculosis in child, injected with Prussian blue and stained with picro-carmine, and numerous others, not only of lung, but spleen, liver, cancers, etc., all of which showed perfectly.

PROCEEDINGS OF SOCIETIES.

ELEVENTH ANNUAL MEETING, AMERICAN SOCIETY OF MICROSCOPISTS.

IT is a cause of regret, in a country where thousands of individuals have not only shown themselves interested, but, in very many instances, have added to our knowledge in microscopical science, that so many should refrain from participating in the annual doings of the National Society of Microscopists. We have repeatedly urged the point, that the presence of those interested in microscopy and general science at these meetings is not so much a direct stimulus to the Society itself, as it is a refreshing mental invigoration to the individual, and that the absence of the individual is to be looked upon more as a personal loss, a lapsing into a state of innocuous desuetude, which is innocent only as touching the Association, for its baneful influence upon the person cannot be estimated. Those who are accustomed to attend the annual meetings of this Society are noticeable as the men who grow, and this growth is markedly observable in the transactions which are given out under the sanction and authority of this scientific body. The comparatively small attendance at the eleventh meeting of the American Society of Microscopists is traceable to several causes: First, the illness of the Secretary, and the consequent unavoidable delay in the publication of the transactions of the Society for 1887, acted as a damper on the enthusiasm of not a few. Second, the postponement of the time of meeting from the middle to the latter portion of the month interfered with the previously arranged plans of many who would otherwise have been present; and, lastly, the inaccessibleness of Columbus by boat and rail.

In spite of these drawbacks, however, a fairly representative audience was present when President Kellicott called the meeting to order on the morning of August 21.

Owing to the sudden illness of Secretary Burrill, the Treasurer, Dr. Mosgrove, was elected temporarily to fill the position. The

forenoon was devoted to the reading and discussion of papers. At the evening session the address of welcome was delivered, in the absence of Governor Foraker, by Mayor Bruck, who happily and gracefully extended the city's greetings to the visiting microscopists. Besides the President's Address, which will appear in full in our next issue, an enjoyable musical programme had been arranged by the ladies of Columbus.

The second and subsequent days of the session saw the ranks of the visitors somewhat depleted by the sudden indisposition caused by the drinking-water of Columbus. In spite of these obstacles, the programme for the morning session in Wirthwein's Hall was carried out, and the following valuable series of papers read: First, The Form and Size of the Red Blood Corpuscles of the Larva of the Lamprey Eel of Cayuga Lake, N. Y., Professor Simon H. Gage, Cornell University; second, Method of Preparing Limpid and Colorless Copal Solution, Dr. F. L. James, St. Louis, Mo.; third, Partial List of the Rotifera of Thiawasser River at Corunna, Mich., Professor D. S. Kellicott, Buffalo, N. Y.; fourth, Dry Mounts, W. H. Seaman, Washington, D. C.; fifth, Development and Reproduction in the Sun Animalcule, I. M. Steadman, Cornell University; sixth, The Bacillus of Leprosy, Dr. C. Q. Jackson, Pittsburg, Pa.; seventh, Cellular Structures of the Black Pepper Berry, Dr. Thomas Taylor, Washington, D. C.; eighth, Examination of Legal Documents with the Microscope, Dr. G. E. Fell, Buffalo, N. Y.

In the afternoon the Ohio State University was visited, and the meeting convened in the physical laboratory. The programme consisted of the following papers and demonstrations: First, Photomicrography with High Power and Lamp Light, with Exhibit of Photo Lantern Slides with Electric Light, Dr. H. J. Detmers; second, Projection of Colored Photographs of Crystals of Butter and other Animal Fats, Dr. Thomas Taylor, Washington, D. C. Besides this food for mental assimilation, the ever-thoughtful ladies of the local committee, knowing the feebly nutrient qualities of scientific disquisitions, furnished other delicacies appealing more directly to the physical qualifications of the scientific throng.

Thursday morning's session was largely given up to the routine business of the Society, the appointing of a nominating committee, etc., time being found, however, for several papers.

In the afternoon the working session took place. Owing to some lack of co-operation on the part of the local committee and a misunderstanding of the requirements of the session, this, one of the

hitherto, most important features of the annual convention, was sadly neglected. We cannot here comment on the want of appreciation of this valuable means for interchange of thought and method, but at a not distant date we shall hope to have something to say on this subject.

The soiree, which is always the most pleasant feature of the meeting in the public's eye, was held in the evening, and a large number of interesting objects shown.

Friday morning the nominating committee announced the following gentlemen as candidates for election:

For President—William J. Lewis, M. D., F. R. M. S.

For Vice-Presidents—Frank L. James, M. D., Ph. D.; A. M. Bleile, M. D.

Executive Committee—Dr. F. O. Jacobs, C. C. Mellor, Dr. W. H. Seamen.

On motion Secretary Burrill cast the vote of the Society, and the members whose names were presented were declared elected. After the Treasurer's report and a short business session, the Society adjourned.

On invitation of Dr. F. O. Jacobs, of Newark, O., the Society took train at 11 o'clock for that city. A deputation, headed by the Mayor, met the incoming train, and the visitors were soon seated in private carriages and whirling over the pleasant roads towards the fair grounds, where is one of the most perfect of the Indian mounds for which the district is noted.

The Hon. C. B. Giffin, standing upon the Eagle mound in the centre of the so-called "Fort," delivered an interesting and witty address on the archeology of the mounds, after which lunch was served, the group photographed by Mr. Drescher, of the Bausch & Lomb Optical Company, Rochester, N. Y., and the carriages again sought. After several hours spent in viewing a number of other mounds in the vicinity, the party returned to Newark, and were made comfortable at the Tubbs House until 7 o'clock, when supper was served.

After an excellent repast, Mr. Giffin called the Society to order to listen to Judge Hunt, who welcomed the visitors in the name of the city. Speeches were also made by Dr. Bleile, Professor Kellicott, Dr. Lewis and Dr. Detmers. The latter gentleman presented a pair of stuffed frogs, which were gazing down the tubes of two microscopes, the work of Mr. Wellington, of Jackson, Mich. Appropriate resolutions and votes of thanks were offered by Dr.

Seamen, after which President Lewis declared the eleventh annual meeting of the American Society of Microscopists adjourned *sine die.*

We regret that our limited space will not permit us to give a more detailed account of the proceedings of the Columbus meeting. We can only say that the whole affair was most enjoyable and profitable; that the papers read were of a high order and of great scientific value; that the bond of good-fellowship was more closely knitted, and that all present left for their respective homes determined that the meeting for the coming year should be the best ever held by the Society. Buffalo, N. Y., will probably be selected as the most desirable point for the next annual session.

ELEMENTARY DEPARTMENT.

RUDIMENTS OF PRACTICAL EMBRYOLOGY.*

W. P. MANTON.

THRELFALL'S METHOD.

§ 12. In this method a film of India-rubber is used on the slide instead of shellac. The India-rubber solution is made by dissolving the pure gum, which may be had in any quantity of dealers in rubber goods, in chloroform or benzine.

The rubber must be cut up into very small pieces and placed in the solvent. But little of the former is necessary, and it dissolves quite slowly.

A film of the rubber solution is spread on the slide by means of a brush, and allowed to dry. The sections are arranged on the slide, which is then heated as above directed, allowed to cool, and then placed in benzoline† for a few moments, to dissolve out the paraffin, and then mounted in balsam.

If desired, the sections may be stained after they have been fixed to the slide. To do this, after immersing in the benzoline, wash in absolute alcohol, then in weaker alcohol, stain, wash in 95 per cent. alcohol, return to absolute alcohol, clear with clove oil, and mount in balsam. Creasote may be substituted for the clove oil, but the latter is better.

The disadvantage of this method is that the sections remain loose until fixed by the heat, and are therefore liable to become disarranged and scattered.

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*Copyrighted 1888.

†Xylol or any other solvent may be used.

GAGE'S METHOD.*

§ 13. Prepare the following:—

Gun cotton (that used by photographers),	2 gms.
Sulphuric ether,	15 cc.
95 per cent. alcohol,	10 cc.
Clove oil,	100 cc.

Dissolve the gun cotton in the ether and alcohol, add the clove oil, and filter.

Label—Schallibaum's Clove-oil Collodion.

A thin layer of this collodion should be painted on the slide just before using.

When the sections have been arranged, heat the slide carefully over the spirit-lamp flame, let cool, and immerse in some solvent, as benzine, xylol, chloroform, turpentine, etc., to get rid of the paraffin. Rinse in 95 per cent. alcohol and clear in the following agent:—

℞	Turpentine,	3 parts.
	Carbolic acid,	2 parts.
	Mix.	

Label—Clearing mixture.

The sections are then protected by a cover-glass which has received a thin coating of the following:—

℞	Pure Canada balsam,	25 gms.
	Chloroform,	2 cc.
	Clove oil,	2 cc.
	Mix.	

The clove oil dispels all cloudiness.

If the specimen has not been stained *in toto*, the sections on the slide may be treated in this manner: After immersing in the solvent and rinsing in 95 per cent. alcohol, place in the stain immediately, if this is an alcoholic solution, otherwise wash first with water. On removing from the stain wash in alcohol, or first in water if the stain is an aqueous solution. Clear and mount as above.

THE *Microscopical Bulletin* calls attention to the fact that in determining the magnifying power of a lens, the rule used should *always* be placed at a uniform distance of ten inches from the eye, and not on the stage of the microscope, unless that happens to be at the required distance.

*Proceedings Am. Society of Microscopists, 1884.

EDITORIAL.

ADULTERATIONS.

IF self-protection is among the first of the laws framed in the heart of humanity, a wonderful inconsistency exists in the indifference which is manifested in regard to the sophistication of foodstuffs, and the employment of harmful materials in the manufacture of articles used in connection with daily existence. The statute books of the various States are woefully deficient in laws touching the substitution of the false for the genuine, the harmful for the good, and, as a result, unscrupulous dealers and manufacturers continue to impose on an innocent and ignorant public.

If the adulterant of a foodstuff is harmless in itself, no particular evil may result, and the perpetrator of this outrage against his fellows may long remain unsuspected; for usually not until some marked disturbance results is the attention of the public directed to the guilty party. Certain efforts have already been made to control the purity of a few of the commoner articles of food, such as milk, butter, etc., but the laws passed have operated only in certain cities and States, and have not been of universal service. What is needed is a general law, applicable in every State, and this should be followed by the constant and careful inspection of all materials used as food. Until such a law is framed direct teaching of the people is necessary. This can be accomplished by the published analyses of adulterated materials. It is with no small degree of satisfaction that we notice the efforts of the United States Commissioner of Agriculture in this direction. In the thirteenth bulletin, issued by the Agricultural department, the adulteration of butter, etc., is further illustrated, and a series of helio-caustic plates of Dr. Thomas Taylor's fat crystals served to illuminate the text. We are glad that the investigations of the government will not stop here, but that it is proposed to continue with all articles of food which are likely to be sophisticated. Turning to the last report of Dr. E. S. Woods (*Am. Analyst*), whose work in this line for the Massachusetts Board of Health is well known, we find that the fraudulent and deleterious adulteration of foodstuffs is extended to an almost infinite variety of materials. Thus, of 1,676 samples which Dr. Woods examined, 498 were adulterated. Now, while it is usual to find that these adulterations are merely the subtitutions of a cheaper for a more costly material—the former being nearly always of a harmless

nature, as in the case of black pepper, the most common adulterants of which are ground cracker, corn, rice and buckwheat, yet the consumer is deceived into paying a high price for worthless matter, and cheats the system of that good and wholesome substance which is supposed to be supplied. It seems to us that self-protection against this form of fraud should be the concern of every one, and as a large number of these adulterants can be readily recognized by means of the microscope, as we have before pointed out, every pharmacist and physician, and especially the health officers of our larger cities, should endeavor to keep the people posted in regard to the various brands of foodstuffs which are found to be other than absolutely pure.

If microscopists were on the alert to expose this nefarious business, not many years would elapse before it would be as difficult to find adulterated foodstuffs as it is now easy.

MR. EDWARD PENNOCK calls our attention to an item on making sections of buds, which appeared in our July issue credited to another journal as having first appeared in the *Microscopical Bulletin*. We are very glad to place the credit where it belongs.

IN reply to inquiries in regard to the late Joseph Zentmayer, of Philadelphia, we are able to state that the firm will continue under the management of his two sons, whose long connection with their father in the manufacture of optical goods will doubtless enable them to maintain the high reputation attained by the founder of the house.

ABSTRACTS.

A CURIOUS CASE OF MIMICRY.

A CENTRAL AMERICAN orchid, *Maxillaria Lehmanni*, exhibits a form of mimicry which has not heretofore been observed. On the central portion of the labellum or lip is a collosity which Herr J. M. Janse observed is covered with a fine yellow powder, which bears a very close resemblance to pollen grains, and like them contains much nutritious material. To the bees which visit the flowers they answer the same purpose, and are devoured eagerly, the insects apparently mistaking them for pollen. While moving about on the labellum, however, gathering them up, they are

certain to come in contact with the sticky dished pollina, and withdraw them from the anthers, and in their visits to other flowers of the same species, bring them in contact with the stigmas, and so effect cross-fertilization. These mimic pollen grains are produced by the dissociation of the cells composing the numerous moniliform hairs borne on the labellum. This is the first recorded instance where plant hairs have been adapted to such an end.—*The Western Druggist.*

TOMATO "BLACK SPOT."—The tomato disease called "black spot," caused by *Cladosporium Lycopersici* Plowright, seems to have become very virulent in England. *The Gardeners' Chronicle* for Oct. 1, figures and describes it. The fungus seems first to attack the decayed remains of the style, while the fruits are small and green, and thus gains access. The remarkable flattening of the apex of the fruit is one of the peculiarities of the disease.—*Botanical Gazette.*

ICE LENSES.—The London correspondent of *Le Moniteur de la Photographie* writes to that journal, that in the middle of the winter which has just elapsed, a student made a lens of ice, with which he lit the pipes of some of the skaters on the Serpentine, by means of the solar rays—an experiment, he says, which was first performed in the polar regions, by Dr. Scoresby, to the great astonishment of the sailors, for they could not understand why the ice did not freeze the beams of the sun. We may remark that Prof. Tyndall at times would set fire, at the Royal Institution, to a little heap of gunpowder, with rays from the electric arc, concentrated upon the powder by means of a lens of ice. His explanation was that, although ice absorbs rays of certain wave lengths, and is gradually melted thereby, other waves it does not absorb, and these latter produce the heating effects at the focus of the lens. It is wholly a question of the relative motions of the molecules of frozen water and the motions of the waves of light. When there is discord between the two, the discordant waves pass through the ice without absorption. —*Scientific American.*

ALGÆ IN THE STOMACH OF FISHES.—An Italian naturalist has been studying the contents of the stomachs of various fishes, with the result of finding numerous fruits and spores of algæ of various kinds, and he believes these animals are important agents in dissemination of these plants.—*Western Druggist.*

BACILLI IN SALT WATER.—This is the title of an extremely dubious report of Assistant Surgeon J. J. Kinyoun, U. S. M. H. S., which is going the rounds of the medical press, that purports to show the infection of the water of the Lower Bay of New York with cholera germs from Hoffman's Island, or by the choleraic discharges of patients detained there or on board the cholera ships anchored in the Lower Bay last summer.

That salt-water bacilli may be found in the waters anywhere in the harbor of New York at any time is highly probable, when we take into consideration the thousands of tons of sewage discharged therein daily; but that cholera bacilli have been discovered among the host of scavengers of the bacilli kind always to be found under such circumstances is too far-fetched for reasonable belief.—*The Sanitarian.*

NEWS AND NOTES.

A MONUMENT to Cohnheim, the distinguished microscopist, has been unveiled at Leipsic.

WATERMELONS, which are now in season, furnish a ready and excellent material for the study of karyokinesis in vegetable cells. The various parts of the ripe core will, if properly treated and examined, give views of the entire process.—*National Druggist.*

INSTEAD, therefore, of the demons which were once thought to be the cause of disease, and to require to be exorcised; and instead of the almost equally imaginary vital spirits and humors which succeeded to the demons when they were discredited, the patient microscopist traces and makes known the life-histories of the minute organisms which he demonstrates to be the causes of many diseases. * * —*Maudsley.*

A MICROSCOPICAL society has just been formed in Italy, the transactions of which will publish the papers presented at its meetings in the language in which the latter are written—Latin, Italian, French, German and English.

THE June number of the *Microscopical Bulletin* contains an excellent portrait of the late Joseph Zentmayer.

BOOK REVIEWS.

THE MICROSCOPE IN THEORY AND PRACTICE: Translated from the German of Professor Carl Naegeli and Professor S. Schwendener; with numerous illustrations. London: Swan Sonnenschein, Lowrey & Co., Paternoster Square. Philadelphia: Jas. W. Queen & Co. Cloth, pp. 374. 1887.

German-reading microscopists have long been familiar with this work, and English readers are to be congratulated on now being able to obtain such an excellent translation of part of it. The revision of the translation was begun under the direction of Mr. Crisp, the well-known secretary of the Royal Microscopical Society, and was completed under Mr. John Mayall, Jr., one of the editors of the *Journal*. Unfortunately, just as the work was finished, all but the part now before us was destroyed by fire. So far, however, as the theory of the microscope and its accessories goes, this part is perhaps the most important of the whole work. As the work is above criticism, we can but give an idea of its contents, in order that our readers may become aware of its helpfulness in much of their work.

The whole work originally consisted of ten parts, the last three, treating of Microphysics, Microchemistry and Morphology, being the ones destroyed. The seven parts remaining are devoted to the following subjects: Part I., Theory of the Microscope, including its component parts, the objective and eye-piece; chromatic and spheri cal aberration; optical power of the microscope; illumination, etc. Part II., The Mechanical Arrangement of the Microscope. Part III., Testing the Microscope, discussing the testing of the optical power, spherical aberration, chromatic aberration and flatness of field; determining the angle of aperture; magnifying power and focal length. Part IV., Theory of Microscopic Observation, treating of observing objects of different forms; interference phenomena; oblique illumination, etc. Part V., The Simple Microscope and Lantern Microscope. Part VI., Technical Microscopy, including the preparation, preservation and treatment of microscopic objects, together with the measurement and drawing of them. Part VII., The Phenomena of Polarization.

All of the subjects are handled in a most masterly way, and illustrations are added wherever required. The work should be in the hands of every advanced microscopist, and, though necessarily quite technical, the beginner will be able to extract much knowledge not found elsewhere.

ABDOMINAL SURGERY, by Hal C. Wyman. Physicians' Leisure Library. Geo. S. Davis, Detroit.

This latest addition to an interesting and valuable series deals with experiments which the author appears to have made on dogs and rabbits. As all of these, including the various intestinal sutures, etc., have been done repeatedly, and are treated of and figured in most of the modern text-books on general and abdominal surgery, there is little or nothing in the book that is new. We cannot agree with the author that society will be benefited by experiments of all kinds on animals, by all kinds of individuals claiming to be doctors of medicine. While in some instances such preparatory work might be of benefit, in the majority of cases it would be wholly lost, the only result being suffering for the animal. Could abdominal surgery be restricted to the few, as it should be, the statistics in this country would be greatly improved. In covers, paper and typography this is an attractive volume.

CATALOGUE OF MOUNTED OBJECTS FOR THE MICROSCOPE, by Miss M. A. Booth, will be welcomed by those who are acquainted with that lady's excelent work. 22 pp.

REVIEW OF THE RECENT PROGRESS OF ELECTRICITY, by Charles H. Merz, A. M., M. D. Reprint.

RECTAL INSUFFLATION OF HYDROGEN GAS, an Infallible Test in the Diagnosis of Visceral Injury of the Gastro-Intestinal Canal in Penetrating Wounds of the Abdomen. By N. Senn, M. D., Ph. D. Reprint.

THE FRENCH VITICULTURAL MISSION TO THE UNITED STATES: Bulletin No. 3, Texas State Geological and Scientific Association.

FOOTPRINTS OF A PROFESSION; OR, ETHICS IN MATERIALS AND METHODS, by Horatio C. Merian, D. M. D. Second edition.

QUEEN'S PRICED AND ILLUSTRATED CATALOGUE OF MICROSCOPES AND ACCESSORIES, ETC. Sixty-eighth edition, 1888.

YEAR-BOOK OF ALBION COLLEGE, 1887–88.

MAGILL UNIVERSITY ANNUAL CALENDAR FACULTY OF MEDICINE, 1887-88.

THE MOVEMENT CURE: AN INTRODUCTION TO THE HISTORY, PRINCIPLES, APPLICATION AND METHODS OF ACTION OF THE MOVEMENT CURE. By Mark S. Purdy, M. D. Illustrated. Price, 25 cents.

This little pamphlet is a clear exponent of the method of manual and mechanical massage, the cases to which this treatment is adapted, and some of the results to be expected. It is an excellent synopsis for the medical man.

PROSPECTUS ST. LOUIS COLLEGE OF PHARMACY, 1888-89.

SUPPLEMENT TO JOHN WHELDON'S CATALOGUE OF ZOOLOGICAL WORKS, London.

COCAINE DOSAGE AND COCAINE ADDICTION—COCAINE TOXAEMIA. By J. B. Mattison, M. D., Brooklyn, N. Y. Reprint.

MERCK'S BULLETIN.

This excellent little sheet furnishes a record of new discoveries in drugs and their application in medicine. From the examination of the copy before us, we should judge it to be of considerable service in posting physicians in the latest remedies.

CORRESPONDENCE AND QUERIES.

643 BROADWAY, ALBANY, N. Y., July 3, 1888.

To the Editors of The Microscope:

GENTLEMEN—Enclosed please find a table of measurements, which I would ask you to kindly give to the readers of THE MICROSCOPE through its columns—if possible in the next issue.

As I found that the measurements of the committee of the A. S. M. and mine did not agree, I went to work to investigate what the cause of the variation might be, and this is the result.

During the last six months I have worked quite a number of days investigating into this matter, and to convince myself that the difference was caused by the various applications of illuminations, etc., as given in the table. Yours very truly,

CHAS. FASOLDT, SR.

MEASUREMENTS.

Table showing the variation in measurements due to the different applications of light and illuminations.

The image of $\frac{4}{10}$ inch was the object on which these measurements were made, and was ruled on a glass disc of No. 2 covering glass, $\frac{7}{1,000}$ in thickness.

All measurements were taken on one and the same ruling, with the same microscope, objective and eye-piece, under the same focus, and having the microscope in the same position continually, and only changing the mirror and excluding the one light while the other was used.

UNMOUNTED.

Lamplight.

Lines Downward.		*Lines Upward.*	
Concave mirror, $\frac{4}{10}$ in.....	$\frac{10}{100,000}$ −	Concave mirror, $\frac{4}{10}$ in.....	$\frac{10}{100,000}$ +
Plane mirror, $\frac{4}{10}$ in.....	$\frac{5}{100,000}$ +	Plane mirror, $\frac{4}{10}$ in.....	$\frac{14}{100,000}$ +
Ill. through objective, $\frac{4}{10}$ in.	$\frac{5}{100,000}$ +	Ill. through objective, $\frac{4}{10}$ in.	$\frac{15}{100,000}$ +

MOUNTED ON GLASS.

Lamplight.		*Daylight.*	
Concave mirror, $\frac{4}{10}$ in.....	0	Concave mirror, $\frac{4}{10}$ in.....	$\frac{30}{100.000}$ +
Plane mirror, $\frac{4}{10}$ in.....	$\frac{15}{100.000}$ +	Plane mirror, $\frac{4}{10}$ in.... ...	$\frac{20}{100.000}$ +
Ill. through objective, $\frac{4}{10}$ in.	$\frac{31}{100.000}$ +		

A number of comparisons were made at each position and in the same temperature.

A Spencer objective was used for these measurements. But Bausch & Lomb and Gundlach objectives were also tried, obtaining the same results.

The microscope used is one constructed on my late patents, and has a micrometer for measuring similar to a cob-web micrometer. But instead of cob-webs, three movable steel pointers are used which are worked as fine as this metal will permit. The stage is mechanical, and the main slide is moved with great precision by a fine screw, 100 threads per inch.

Subscriber: There are two grades of paraffin used in embryological and other microscopical work, for embedding. In winter the hard grade is rather too hard, and requires to be softened with the paraffin having a lower melting point, say in the proportions of 1 to 3. It is important, too, in making serial sections, that the block, or at least the paraffin around the embryo, shall be soft enough so that the edges of the sections will adhere. For making very thin sections of animal tissues, the hardest paraffin is the best.

AS A result of the microscopical examination of a tooth implanted by Younger's method, Curtis concludes that the inflammation consequent to the formation of the new socket produces an infiltration of osteoblasts into the cementum of the implanted tooth, which results in bony anchylosis, thus fixing the tooth firmly in place. He believes that not only the cementum recovers its life, but also the dentine of the root, his sections showing that the dentine fibres were not shrunken, and that the peripheral cells of the pulp, the odontoblasts, were alive.—*Boston Medical and Surgical Journal.*

DR. STERNBERG has been studying the liquefaction of gelatine by bacteria, and has ascertained that it is due to a soluble chemical product which is formed during the active growth of the liquefying organisms, and that a comparatively small amount of this substance will liquefy gelatine quite independently of the living organism. Dr. Sternberg expresses the hope that some chemist will take up the question with a view to ascertaining the exact nature of this substance.—*Science.*

EXCHANGES.

This department is for the benefit of SUBSCRIBERS *who have microscopical apparatus material or books which they wish to exchange, and such wants will be* INSERTED FREE OF CHARGE. *The number of insertions given will depend upon the number of exchanges received each month. Subscribers will please notify us when articles have been exchanged or sold. Dealers are referred to our advertising department.*

FOR EXCHANGE—A collection of seeds, botanical and miscellaneous material, for diatoms, either mounted or in tubes. W. F. ROCHELLE, Jackson, Tenn.

WANTED—THE MICROSCOPE, Vol. 6, Nos. 2, 3, 4 and 5. Address
H. M. WHELPLEY, 2647 Olive St., St. Louis, Mo.

FOR EXCHANGE—I have a limited number of slides of each of the following: Strychnia Chromate (Strychnia 1-250 gr.) and Strychnia Ferri-Cyanide (Strychnia 1-100 gr.) which I will exchange for other slides, "botanical" preferred. Only first-class slides offered or desired. L. A. HARDING, Fergus Falls, Minn.

FOR EXCHANGE—Slides of named diatoms.
H. W. WESTOVER, St. Joseph, Mo.

FOR SALE AT A BARGAIN—Microscopical slide cabinet in solid walnut, handsomely finished and perfectly new. Capacity, 1,200 slides lying flat. This cabinet was made to order, and is of good workmanship throughout. For full description and price address
F. J. EVANS, M. D., 99 Christopher St., New York City, N. Y.

FOR EXCHANGE—The best and most convenient drying clip ever made, for good mounted slides. These clips are in use by some of the best workers, and once tried are a necessity. Also light saws for bone sections for exchange.
F. W. LOWDER, Sioux City, Iowa.

WILL EXCHANGE for objectives or other microscopical appliances, a Standard Columbia Bicycle, 48 in. large wheel, in good condition. Address
J. R. CHATHAM, Xenia, Ill.

FOR EXCHANGE—A Maynard Creedmoor Rifle and loading tools, all in good condition, for a microscope of some reliable make—Bausch & Lomb's Investigator or Physicians' preferred. For further particulars, address
J. H. BARR, Box 1471, Rockford, Ill.

WANTED TO PURCHASE—Copies of works on microscopy not already in my library.
H. M. WHELPLEY, 2647 Olive St., St. Louis, Mo.

WANTED—A polariscope to fit large stand; Bausch & Lomb No. 10 bb. preferred. Also sub-stage condenser. Address, stating price wanted,
ERNEST P. DEVILLE, No. 75 Royal St., New Orleans, La.

WANTED TO EXCHANGE—For histological slides of human tissues. Have on hand slides of necturus and turtle blood corpuscles, embryonic mole and various cat tissues. Address T. D. WOOD, Box 322, Sycamore, Ill.

WOOD ENGRAVER'S TOOLS, BOOK, Etc.—Cost about $10, for a 1 inch Huyg. Ocular, adapted to B. & L.'s "Model," slides, books or cash.
A. E. WARREN, Rio Vista, Virginia.

GOOD HISTOLOGICAL SLIDES FOR OTHER GOOD MOUNTS.—I will cut good Histological or Pathological material on shares for those not provided with microtomes.
S. G. SHANK, M. D., 547 Clinton Ave., Albany, N. Y.

FOR EXCHANGE—Mounted sections of injected human kidney.
GILMAN DREW, 104 Bloomington St., Iowa City, Iowa.

WANTED—"Synopsis of North American Lichens," Tuckerman, and "Manual of the Mosses of the United States," Lesquereux & James. Will give fine slides or cash.
H. M. RICHARDS, 27 Ellery St., Cambridge, Mass.

FOR SALE—Zentmayer histological stand, Rack coarse adjustment, micrometer fine adjustment, B eye piece, good as new. 40 per cent. discount. Also, objectives 1½ and 8-10 Zentmayer, first class, and B. & L. ½ inch.
A. G. FIELD, M. D., Des Moines, Iowa.

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Specimens for examination should be sent to the *Microscope Laboratory*, 25 Washington Avenue, Detroit, Michigan. In all cases the transportation charges on these specimens must be prepaid, and special directions for packing and shipping will gladly be sent upon application.

VOL. VIII. DETROIT, OCTOBER, 1888. No. 10

ORIGINAL COMMUNICATIONS.

PRESIDENT'S ADDRESS, AMERICAN SOCIETY OF MICROSCOPISTS.

COLUMBUS, OHIO, 1888.

THE NATURE OF PROTOZOA AND LESSONS OF THESE SIMPLEST ANIMALS.

D. S. KELLICOTT, PH. D., F. R. M. S.

Fellows of the American Society of Microscopists, Ladies and Gentlemen:

IN accordance with a well-established precedent, and by your kindness, it is my privilege to address you this evening hour of the first day of the annual meeting. In making choice of a theme, I have been guided largely by the safe examples of my learned and distinguished predecessors who have addressed you on similar occasions, and who have preferred to discuss topics pertaining to their special fields of research, rather than to present a general review of the progress towards the perfection of the microscope and its accessories, or to the mass of varied research with the instrument. The President, last year, at Pittsburg, in beginning his address, said: "Microscopy is more nearly cosmopolitan in its character than any other science. If I did not believe this I should not have consented to occupy this honorable position which I now hold by your suffrages. I suppose I am indebted to this expression of your confidence on account of the use which I have made of the microscope as an essential factor in a single line of research." Likewise, I am pleased

to think that I owe my present position, first and partially, to the fact that for six of the ten years of the Society's existence, I have been intimately associated with its work, as Secretary, and second, but may I hope chiefly, since in one line of research with the microscope I have succeeded in bringing to light some forms of minute beings, invisible, indeed, to the unaided eye of man; some of them peculiar and hitherto unknown, whilst others had not been previously announced as occurring in the remarkably varied and interesting microscopic fauna of our native fresh waters. So it seems to me entirely appropriate that on this occasion I should not go outside the line of research to which the greater number of my contributions to the Proceedings have pertained; moreover, it is the branch in which you know me best as a naturalist, and concerning which I feel some confidence to speak in your presence. Hence, I shall ask your attention for this hour to a general discussion of the Nature of Protozoa and Lessons of these Simplest Animals, followed by an account of what has been done in America to elucidate this group. But before proceeding with this subject, permit me to extend somewhat these preliminary remarks.

The American Society of Microscopists, like kindred societies everywhere, is composed of those who use the microscope in many and widely different branches and activities; the most useful instrument of investigation yet discovered by the patience and genius of men is the bond of union: it unites those having little else in common save an enthusiastic love of truth, and, naturally, it gives name to these organizations. All who depend upon the powerful aid of the microscope are intensely interested in its improvement and its final perfection. Moreover, the improvements in the methods of its use, and the complicated and delicate operations necessary to its fullest revelations are of scarcely less importance. The microscope and all that pertains to it, its manipulations and the many refinements of methods of research into the constitution of the minute, are, therefore, plainly the first subjects to be considered as the especial province of this Society. These should, unquestionably, receive first place in its deliberations.

This matter was forcibly put four years ago, by Judge Jacob D. Cox, in opening the Rochester meeting of the Society, and quite recently Rev. W. H. Dallinger, President of the Royal Microscopical Society, has expressed similar views. The opinions of these representative men can not be lightly set aside, nor their advice neglected. Their conclusions are the result of rich experience in affairs. The wise man, it is said--and is it not also true of organizations of men?

—is one who profits by the experience of others; the foolish who gains by his own experience only. Is this Society in danger, or is it likely to drift into that unhappy state of forgetting, "That in proportion as the optical principles of the microscope are understood, and the theory of microscopical vision is made plain, the value of the instrument over every region to which it can be applied, and in all the varied hands that use it, is increased without definable limits?" The records will show, I think, to any enquirer, that the chief reason for the Society's being has been remembered thus far in its history, and the wise councilors and guides which it fortunately possesses, give confidence that it will not in the future depart from its safe traditions. The Society has discussed and published numerous papers on the theory and construction of the microscope, new forms, improved methods and devices; it has taken measures, equalled by no other society, to secure a standard of micrometry; it has sought to secure uniformity of tube diameter, improvement in eye-pieces, in the society-screw, etc. Again, besides the papers on microscopy, at every meeting there have been free exhibitions of instruments of the latest forms made at home and abroad, and annually, beginning with the Chicago meeting in 1883, there has been, in addition, a thoroughly organized, practical session or sessions, at which many difficult operations have been explained and demonstrated by those fully competent to teach. The Society, then, surely has not fallen into the grave error of neglecting microscopy for the discussion of the results of microscopical research. And may it ever be kept in mind by those who direct its energies, that the improvements of the "prince of instruments of investigation" and the technics of its applications are the chief aim, work and destiny of this still young and progressive organization.

But how justify my choice of a theme for this evening? First, by the usage of the most renowned microscopical society, the Royal Society of London, the proceedings of which are largely concerned with natural history; second, the custom of this Society, which has grown up in accordance with the wishes and advantages of its members; and third, it seems to me there are good and sufficient reasons why this Society should continue to receive and publish, for the present, at least, the results of microscopical investigation by its members, in whatever field. "Wherefore, by their fruits ye shall know them." Methods and means are judged by established results, tested by comparisons and discussions; such conclusions are verities, the flesh and blood that clothe and beautify and nourish the skeleton, which, in return, gives form, stability and efficiency to the whole.

If the foregoing precedents are not worthy to be followed, or if there are not the good reasons alleged for occupying your attention as a society of microscopists with such subjects as announced, then I have, through an error of judgment, fallen short of the full measure of my opportunities on this occasion.

In the following discourse I have endeavored to keep before me these conditions: First, to mention only such points as reasonably possess a general interest, reserving the more technical results of my study for presentation at the daily sessions; second, to state and illustrate these facts clearly; and third, to occupy a reasonable time.

There is an almost universal desire on the part of the devotees of any particular art or science to date its origin in the remote past. Are we not apt to esteem most highly that which bears the stamp of hoary antiquity ? I am convinced that this is the case, and yet I cannot justly claim that advantage for my specialty. Other reasons must be alleged as a warrant for especial attention to it. Still, the beginning of our knowledge of the simplest animals was laid more than two hundred years ago. The microscope of that time was indeed a primitive instrument. Its evolution had so far progressed that it was something more than a toy. By its aid, at that time, was revealed, in partial vision, it is true, the grand fact, that there exists beneath the waters of every mantled, festering pool, or limpid stream, in lake or river, or in ocean depths alike, myriads of invisibly minute beings, ceaselessly, noiselessly pursuing their work unheeded. As the infinite variety of graceful forms and their strange habits were more and more clearly comprehended, and as the knowledge of a newly revealed animal world increased, the enthusiasm of these early microscopists became exuberant, and with their enthusiasm grew their devotion to Nature and its Author,—a consequence repeated in every student who in the right spirit learns his lessons for himself by his own explorations. Men now possessed, and were beginning to employ, constantly improving microscopical vision; it revealed a world of minute animals and plants, perfect in their way, and actuated and governed by principles and impulses not unlike those controlling the microscopic already known. In these animate atoms were seen anew, or for the first time, certain world problems, and there sprung up fresh hope of their solutions. The origin and nature of life; what guided intelligence adjusts the varied relations and necessities of each and every minute creature to its environment as truly and exactly as in the higher organic forms. Moreover, here and there a broad, unknown domain of nature was opened for exploration by the human intellect, which, at that time,

as it seems to us, was in the attitude of the child toward Nature, eager to know its facts and the reasons for them, seeking knowledge for the sake of knowing. There is no wonder that the early investigators of microscopic life were enthusiastic; they had abundant reason for this directing sentiment, their devotion and patience laid well the foundations of the science of a great branch of animals. Leuwenhoeck, Jablot, Baker, Trembly, Ledermuller, Perty, Muller and Ehrenberg prepared the way for the brilliant discoveries and broad generalizations of a half century just passed by the renowned students of the simplest living beings, The present knowledge of the protozoa does not compare unfavorably with that of any other assemblage of animals, and is advancing as rapidly; this, too, when only comparatively few skilled workers can contribute to this end; and, moreover, these forms are of little or no practical use or importance. Even their once supposed intimate relation as a cause to many distressing maladies, has not been confirmed by recent research, but rather disproved, except, perhaps, in the rare instances of certain blood parasites of aquatic animals. There is then, sufficient love of abstract truth, sufficient enthusiasm in bringing to light new facts and endeavoring to answer grave problems of philosophy, to render possible brilliant discoveries, if not a brilliant scientific epoch. To these sentiments is due our knowledge of and interest in the protozoa.

The animal kingdom is divided into two natural groups or series, the protozoa and the metazoa. The former includes the unicellular forms, or those generally regarded as the equivalent of the histological cell; the latter are multicellular; their tissues are composed of histogenetic elements or cells, and these are arranged in two sets, viz: the ectoderm, or outside body-wall, and the endoderm, or lining of the alimentary cavity. These commence existence as a nucleated cell; their subsequent growth and complexity are the result of cell multiplication and modification mingled with the products of cell life. The protozoa do not pass beyond the primitive stage, *i. e.*, cell division giving rise to individuals. None are modified for the sake of others, and all perform similar functions and all the essential functions of an animal. Truly, then, we have here the simplest forms of animal existence possible. Whilst the life of the metazoon may be regarded as the resultant of hosts of individuals comprising it, and among which, division of labor is fully carried out, on the other hand, in the protozoon, we see manifested by each individual, only the capabilities of one element. In this case, then, we deal with the absolute elements, and not with resultants. Here

the mystery of mysteries seems to be almost unveiled. The nature of life, if it is to be revealed by the study of organisms which exhibit it, should appear from the study of the naked, disassociated, protoplasmic atoms in which all the essential attributes of life are manifested. The simplest of these, for they differ widely among themselves, are without nerves, yet they are sensitive; they are without organs, yet they move about freely; gather, select and digest their food; and escape from their enemies; they reproduce their kind and maintain themselves when subjected to unfavorable conditions with as great certainty as do the complex and bulky animals. In short, their life histories, as we get to know them better, prove to be as definite, the specific characters as constant. But does the clearer understanding of these forms in their simplicity shed light on the nature and origin of life, which are held by many savants not to be transcendental? It seems to me not, and that we are still very far from the solution of these great problems. The most that has eventuated thus far is a shifting of the point of view. This has undoubtedly afforded a clearer sight, but the perfect vision is not revealed. Still, whilst the object sought may be illusive, and, as one who pursues the rainbow finds it ever a few steps beyond his reach, so here, the answers to the questions mentioned, which have been so eagerly sought for in the bodies of the simplest and beginning forms of life, ever elude the microscope and reagents of the enquirer. Then are we no nearer an understanding of these matters than before? Most certainly we are. The problems of human society are not nearly all solved, but there have been tremendous strides in advance since the individual, rather than communities, has been made the object of consideration. Although the results attained are so far short of hopes and expectations, yet, in the prosecution of these inquiries in connection with protozoa, there is fascination and interest. Further than this, the infinite variety, their gracefulness of form and motions, their ubiquity and high endowments, coupled with simplicity, firmly hold the attention of the student.

For the sake of clearness in the subsequent parts of this discourse, let us attend for a few minutes to the organisms themselves, and the terms designating the parts. [To aid in this explanation, simple figures were drawn on the blackboard.]

A cursory survey will disclose the fact that there exist very great differences among these creatures comprehended in protozoa. The reach from the lowest to the highest is immense, comparable only to a corresponding relation between highest and lowest vertebrates; hence, for illustration of terms and for convenience of com-

parison, I have chosen a species near the middle of the series; with this we may hurriedly and easily compare others, higher and lower.

If to a beaker of clear water a few fragments of hay be added, and let stand a few days, there may be found in the infusion great numbers of a small, animated speck, represented by the sketch. It is somewhat egg-shaped or globular, quite soft and elastic, with two similar external appendages, consisting of two long, lash-like fibres. Under the lens the whole organism appears endowed with life. This is attested by its free motion, sensitiveness and ability to appropriate and change to voluntary activity the energy of organic food. The proper tests prove that its substance is identical with that form of matter everywhere associated with life, and called protoplasm. In fact, this animal is little else than this remarkably complex and wonderful substance now universally recognized as the physical basis of life.

This minute lump of matter, only about $\frac{1}{400}$ of an inch in diameter, is naked protoplasm; true, its outer boundary appears to be somewhat denser than the portion included; still, it appears that its food may be taken directly through the surface at any place; there is not a food receiving orifice—a mouth. On examining the globule farther, two important bodies attract our attention. First, imbedded in the protoplasm, may be seen a globule of protoplasm firmer than the surrounding mass; this is the nucleus. This element of the protozoan body, possessed also by the histogenic cell, has elicited much study and animated discussion. Almost every issue of the microscopical and morphological journals bring to notice accounts of new and many far-reaching discoveries regarding it in relation to the career of the cell to which it belongs; second, within the endoplasm may be seen a clear globule which grows until a certain size is attained, when a sudden collapse occurs and it disappears, to again steadily form and disappear as before. The two lashes which arise from the lower, anterior part of the body are extensions of the body protoplasm, hence, possessing its properties of sensibility and contractility. One of these flagella reaches ahead, and by its repeated strokes against the water pulls the body through that medium; the other is used as a director of its course, or sometimes as an anchor. These few differentiated parts are all that characterizes this representative of one of the great classes of one division of the protozoa, viz: the flagellata, the first class of infusoria. By variation of these parts and their products arise those characters and differences on which are established scores of genera that are simpler, and scores that are more complex.

That these germs teeming in the hay infusion are alive, no one questions. But why relegate them to the animal kingdom rather than to the vegetable? It is no longer difficult to refer any one of the complex or multicellular beings to one or the other of these two parallel series; there are no longer serious differences of opinion concerning such among the learned; but to satisfactorily divide unicellular forms, placing this among protozoa, and that one among protophyta is another matter, one which the present state of knowledge does not enable men to agree upon. The distinguished biologist, Ernst Haeckel, has proposed to remove the difficulty by establishing a third kingdom, protista. To this many doubtful species, and many that are not so, have been assigned by him. He has distinguished followers. Still, to many the proposition seems to increase rather than diminish the perplexity, for now we have two questions instead of one to contend with, viz: To separate protista from animals on the one hand, and second, from plants on the other. Again, if I understand aright the tendency of modern research concerning this matter, the number of forms which can not be assigned with good reason to either the vegetable or the animal series, is constantly growing smaller. In short, it seems to me, protista is gradually tapering to a point, as knowledge advances, and at no very distant period there will be no use for it in the sense it was first proposed and limited.

I prefer to keep to the old lines and regard these lowest beings as either plants or animals, according to the best light we have. That mistakes will be made for subsequent study to correct must be expected. But that there will be more than by any yet proposed arrangement, I cannot believe.

This little swimmer from the infusion is known in the system as heteromita. Why is heteromita an animal? 1. It feeds on organic matter of the infusion in which it flourishes. Since it contains in its body none of that peculiar substance, chlorophyl, which enables protoplasm to create its own food out of the simple substances, H_2O, CO_2 and NH_3 in the presence of sunlight. On the other hand, it must borrow its substance and energy from other and independent sources.

At this point two questions naturally arise which are in the nature of exceptions: 1. There are well-known and undisputed plants with the habits of animals, *i. e.*, they feed on organic food prepared outside themselves. Whilst it is a rule that animals feed as our infusorian does, upon the substance prepared ultimately by

plants, and that the plant prepares its own, the fungi and certain colorless flowering plants reverse the rule and are exceptions. That they have acquired this animal habit will not be difficult to believe if we take into account the prevalence of parasiteism, and the wonderful changes and modifications of form and habits which it implies. The fungi are plants, as their life-histories, development and structure attest. Besides, they may feed on such chemicals as acetates, tartrates and ammonia; this animals cannot do. 2. The second exception is this, certain undoubted animals, *e. g.*, the green hydra, some fresh-water sponges and infusoria, are pervaded by chlorophyl-bearing bodies. These are said to possess the power, therefore, of creating their own food in manner similar to the ordinary plant. It should be noted that if it proves to be true that these green animals have acquired the characteristic habit of the vegetable, another fact is added tending to prove that protoplasm of either kingdom is capable of great accommodation or change of habits.

In regard to the question of the possibility of carrying one's vegetable garden in one's stomach, I wish to express a doubt. I can not see that the species whose tissues are filled with these bodies and on which, or on their products, it is supposed to feed, possesses an adequate advantage over those not thus supplied. Our green hydra is not so abundant as the brown one, nor will it hold out longer under unfavorable conditions; it feeds as voraciously. Two masses of fresh-water sponge are often seen growing side by side, one brilliant green, the other colorless. I am unable to see that the green example or the green part has any advantage over its colorless associate. A particular infusorian, holophrya, which I shall refer to at another time during this meeting, occurs in abundance in a certain sluggish stream near Buffalo. It is a deep green, and often imparts its hue to the water and submerged objects on which it accumulates. A number of these were recently taken and subjected to a series of varying conditions, whilst check experiments were conducted with the uncolored *Enchyledon farctus.* Under varied conditions as to light, temperature, air and absence of food, so far as I could determine the green species possessed no advantage as to enduring qualities over the other. The usefunless of these chlorophyl bodies, if they are useful, is not, it seems to me, in the direction of nutrition or respiration.

2. The second reason why *Heteromita lens* is an animal is the course of its life history; this is now reasonably well known, and is

in accord with those of others that are unmistakably of the animal series.

3. Its contractile vesicle is an attribute peculiar to the microscopic animal. True, a similar endowment has been attributed to species of protophyta. I am not convinced that such exist, at least, of the nature and action of those of creatures similar to heteromita.

4. When the motions and behavior of these mites are taken into account, one receives an impression that they are guided by intelligence and a conscious state wholly different from the influences controlling the motions of the one-celled plants. While this is not a high order of proof, it should not be wholly disregarded. It certainly is in constant and instinctive use by those who study these forms.

Heteromita is clearly an animal. How stands the matter with the lowest plasmodic beings? The amœba, *e. g.*, has no definite form, its exterior bounding parts are less differentiated than those of the animal described above. It has no specialized organs of locomotion like this one, while it has a nucleus and contracting or pulsating vacuole; it feeds, also, on organic particles which it takes in the solid state indifferently at any part of its body; and it moves about with a freedom and conscious direction that stamp it as one of the animal series. The very small amœba found in our creeks and ponds could not well be less complex and still exhibit the functions of animal life. Dr. Carpenter's often quoted words characterizing the rhizopoda aptly describe it: "A little particle of apparently homogeneous jelly, changing itself into a greater variety of forms than the fabled Proteus, laying hold of its food without members, swallowing it without a mouth, digesting it without a stomach, moving from place to place without muscles, and feeling without nerves." But there are lower animals, it is said, the monera, for example: "An organism without organs, which consists of a freely movable, naked body, composed of a structureless and homogeneous sarcocle, never differentiating nuclei within the homogeneous protoplasm." Is this existence plant or animal? For one, I am willing to leave it in "No man's land." A large number of the simplest forms once regarded as non-nucleated and without differentiation are on further study found to be nucleated and otherwise not so simple as at first supposed. Monera, it seems, is already limited, and may vanish entirely under the searching scrutiny of recent methods.

So far as the monera is concerned, I have to say I cannot find it. I have ransacked every likely place within my reach at all seasons without encountering such a being. I do not presume to deny its existence because I cannot find it, but I have a sufficiently wide acquaintance with unicellular plants and animals, and with their haunts, to justify me in doubting their individuality so far as my own general conclusions are concerned. I do not, however, wish to speak for others or to influence them in this matter. Both negative and positive results of my studies compel me to doubt that monera, in the sense it was first described, exists, as much as we all to-day doubt the existence of bathybius.

As soon as beings like our heteromita were discovered, there arose the pertinent inquiry, Whence came they? They had no visible ancestry. A few fragments of dried grass put into a clean beaker with clear water, after a few hours brought forth living myriads. Was it therefore true that these and others like them which people every way-side ditch and stagnant pool, came into consciousness and life from the dead by chemical and physical changes therein? It was not necessary to stand upon the belief of such an origin, and yet it was in accordance with the known facts. While mankind was ignorant of nature, fancy peopled jungle and forest with real and unreal animals spontaneously generated. This, too, was logical. Aristotle taught that this was one of the regular and natural modes for the production of living forms. As knowledge advanced, the number of species thus accounted for faded away. After the microscope revealed a new world of minute existences, whose origin was still more difficult to verify, the belief was again strong that these were forms of life without parentage. But one after another of the coarser forms was studied and proved to follow as definite a life history as the largest animals.

Recent progress in drawing hard and fast lines about the personality of the myriad species of minute organisms leads us to wonder that so late as 1871–2, in the Proceedings of the American Association for the advancement of Science, and also in the *New Haven Journal of Science and Art*, same date, pp. 20 and 88, there appeared a discussion seriously purporting to trace a sequence of forms from protococcus or chlamydococcus to the spirally pedunculate vorticella, then oxytriella and perhaps rotifer.

This is truly imaginative and poetic "science." The day for such is almost, but not wholly, gone; but the "beginnings of life" have served their time, let some other branch hereafter have the honor.

Finally, within the last quarter of a century, largely by men still living, the contention over the spontaneous derivative, more especially of the simplest plants, the bacteria, has been animated, the experimentation and analysis exact and searching. Undoubtedly, the result has been a disbelief, on the part of a great majority of naturalists, in archebiosis. On the other hand, there are those who maintain that it is not so much a matter of experiment as a logical sequence of the doctrine of evolution.

Following the astronomer's ideas of the evolution of the earth, there was a time when the conditions were such that life could not exist; afterwards, conditions were favorable, the lowest forms originated spontaneously by the forces of nature, and, from these beginnings, all subsequent hosts, great and small, have been evolved.

The more conservative philosophers, who can believe in the spontaneous generation of life only on experimental evidence, are, nevertheless, logical in holding a belief in evolution of plants and animals as a fact, since the natural laws known as Darwinism apply only to already existing conscious forms. To this class the origin of life is a mystery, transcendental.

Our swarms of heteromita, then, arose in the nutrient infusion from germs derived from air and water, or by clinging to the hay. These germs, in turn, took their origin and potentiality from heteromitas infinitely near this one in characters, and so, backward, indefinitely from another so-called species or an original ancestral form for whose origin science is not able to account.

Admitting the distinct nature of the two parallel series of living beings, derived by the evolutionary processes, from a created beginning, this interesting question arises, *i. e.*, Which was first established? As they are now found related, one sort depends wholly upon the other for the creation of those complex compounds which serve them for food, the source of substance and energy. Unless this dependance of animals is an acquired habit, as a parasite acquires habits of feeding upon the substance of its host, and at the same time loses the ability to procure its food independently, the vegetable representative must have preceded the animal. Paleontology affords no evidence affecting the question one way or the other. The earliest evidence of life in the Laurentian rocks points to the cotemporaneous existence of plants and animals. In the absence of facts, men speculate. A certain chemical compound, chlorophyl, seems to be necessary to protoplasm that it may maintain and increase itself. Hence the query, Was the primitive protoplasm

like that of animals without chlorophyl or like that of plants supplied with it? An eminent English scientist has suggested the possibility, at least, that animals preceded plants. The following is a statement of his views: "A conceivable state of things is that a vast amount of albuminoids and other such compounds had been brought into existence by those processes which culminated in the development of the first protoplasm, and it seems likely enough that this first protoplasm fed upon these antecedent steps in its own evolution, just as animals feed on organic compounds at the present day.

"At subsequent stages in the history of this archaic living matter, chlorophyl was evolved, and the power of taking carbon from carbonic acid. The green plants were rendered possible by the evolution of chlorophyl, but, through what ancestral forms they took origin, or whether more than once, *i. e.*, by more than one branch, it is difficult even to guess. The green Flagellate protozoa (volvocineæ) certainly furnish a connecting point by which it is possible to link on the pedigree of the green plants to the primitive protoplasm. Thus we are led to entertain the paradox that, though the animal is dependent on the plant for its food, yet the animal preceded the plant in evolution, and we look among the lower protozoa, and not among the protophyta, for the nearest representatives of that first protoplasm which was the result of a long and gradual evolution of chemical structure and the starting point of the development of organic forms."

To those who profess to believe in the production by chemical evolution of protoplasm as a specific being reproducing itself, this ingenious "paradox" is well nigh unavoidable. Chlorophyl is a product of protoplasm, and could not well precede in evolution its cause. But this, plausible as it is, depends on too many pure assumptions. It is broached only because it seems to be a logical sequence of a theory which can not be proved, and of which many dispute even the probability. It must be assumed, first, that there was, in the remote time of primordial life, produced by chemical reactions alone, a mass of albuminoids from which protoplasm could and did spring, and on which it could subsist until an oncoming sense of hunger, as the supply of organic food produced without antecedent life disappeared, suggested or caused or resulted in the production of chlorophyl, by which means the supply was replenished. Second, the nature and relation of the animate kingdoms, as they now exist, were once different, or reversed. Neither of these propositions is sustained by a particle of chemical, biological, or

paleontological evidence. The past must be judged by the present. To preserve respect for the scientific method and the conclusions derived therefrom, unnecessary speculation should be avoided. For one, I prefer to hold, for the present, at least, the belief that in the beginning living organisms were created in their simplest forms; from these succeeding floras and faunas have been evolved.

We do not begin to know the nature of force, of matter, or the origin of motion, yet we study and investigate their laws and natural relations, and are satisfied. We rest our inquiries as to whence and what, and partly admit that these are questions past finding out by one philosophy. So, too, we may logically examine the phenomena of life, past and present, without being able or assuming to explain, on scientific grounds, its essence or origin. I am willing to admit the creation of protoplasm, and chlorophyl, too, if necessary, by a power that is beyond nature as we understand the term.

Still, I admit that the question of archebiosis is not necessarily and forever settled; it may yet be attacked and proved experimentally by some one endowed by a peculiar genius for experimentation, one who shall be able both to see and to artificially reproduce those conditions and combinations of matter and forces, chemical and physical, which existed during the ages preceding the formation of the oldest fossil bearing rocks.

Until such genius arises, or light breaks in from some other source, I say again, I think it quite as logical and as satisfactory to keep to the old lines, at least so far as to believe that, up to a certain stage in the progress of the material world, there were no living beings, then they were created by an Almighty Power, not expressed by conditions and chemistry. I hold this simply as a naturalist, for consistency's sake, and in order to go no farther than the evidence warrants, so I am free to follow the lead of truth, no matter whither it may direct.

The variety of types of the protozoa is very great. This can scarcely be appreciated except by long and intimate study. There is neither time or reason for an enumeration of these characters and peculiarities, although it would be interesting to trace the advance in characters. As we proceeded, from the highest to the lowest of the groups, we should find each type more or less intimately connected with those both above and below; that is, the line of phylogenetic descent is as clearly traceable in the protozoic as in the metazoic branches of the animal kingdom; but this is not all, for we find certain infusoria, for example, which are evidently the types connecting

the origin of the higher groups with the lower. We should also note, often with astonishment, the remarkable capability of the disassociated, specific cell, and, by the proper comparisons, find at every stage, that the same functions or attributes persist in the associated units of animal tissues.

The protozoa are separated into two grand divisions, rhizopoda and infusoria. The simplest of the former are naked, possibly reticulated protoplasm only, nucleated, and usually with a pulsating vacuole; they lack all specialized organs of locomotion, prehension or digestion, whilst the most highly specialized infusoria have thin protoplasm surrounded by a firm, protecting and bounding wall, well defined, and often complexly differentiated apertures for the reception of food; their bodies have definite shape and their organs of locomotion are well developed. But from the lowest to the highest may be traced such plain, biogentic relations that the development of the highest from lower is unmistakably revealed. Regard, for an example, the sedentary tentaculifera, the most highly developed of the infusoria; they give birth to ciliated, free-swimming embryos, resembling closely the adults of one of the three classes of the ciliata which are less highly organized. This peculiar characteristic in the embryology of the tentaculifera seems to conclusively demonstrate their higher rank compared with the ciliata. On the other hand, the adults are, without doubt, allied to the metazoic hydrozoa, which, also, have cilitated embryos attesting their ascent from the ciliata through the tentaculifera. So not only do the structural peculiarities and developmental phenomena of the unicellular animals plainly teach derivation by bigenetic descent throughout the branch, but also indicate the starting point of various types of the metazoa. In substantiation of this proposition, it may not be amiss to point out examples in proof. Since the succession of embryonic characters of the higher species appears to trace, more or less certainly, the ancestral or developmental history of that species, the connecting stages of the two branches of animals are, in many cases, already established. The larvæ of the star-fishes and sea-urchins are free-swimming, little bodies surrounded by bands of cilia which unmistakably disclose the ancestral affinities of the echinoderms with the Peritrichons ciliata, the class of infusoria to which the well-known vorticellæ or bell-animalcules belong. Another illustration may be mentioned. In the intestines of the common frog, or toad, may at any time be found a flat, mouthless infusorian known as *Opalina ranarum;* it is covered throughout with fine, even cilia. There hatches from the eggs of the cœlenterata an animal not resembling

the parent, but a ciliate type, the planula, so closely resembling the parasite from the frog that only an experienced observer can appreciate the difference. Indeed, the great naturalist, Louis Agassiz, so late as 1852, in the *New Haven Journal of Science and Art*, declared that opalina was the missing link in the history of distoma, a genus of parasitic worms, and, further, that the embryo hatched from the egg of a planarian (another worm) was a genuine, polygastric animalcule of the genus paramecium. In the same paper he says, referring to the above, "with such facts before us, there is no longer any doubt respecting the character of the polygastrica; they are the earliest larval condition of worms." He adds also this: "Since I have ascertained that the vorticellæ are true bryoza * * * there is not a type of these microscopical beings left which hereafter can be considered a class by itself in the animal kingdom." These sentences are not quoted to call attention to an error of our revered naturalist, but to show, more thoroughly than a mere statement would do, the absolute similarity of the ciliate embryos of certain metazoa to ciliate infusoria.

The study of protozoa in the light of the above and for the sake of elucidating such questions of world-wide interest cannot be lightly esteemed.

The simplest rhizopoda, as stated above, consist of naked reticulated protoplasm; from this unmodified beginning may be traced ever increasing complexity of structure. The locomotory organs may serve for an example. The uncovered forms move in two ways, by a flowing or streaming of the protoplasm as a whole, or by the protrusion of finger-like processes or threads of the body substance, called pseudopodia, which are transient or held by a permanent firm axis. Their power of extension and retraction render them organs of locomotion and prehension.

The corticated forms have, protruding from the surface at well defined regions, thread-like extensions of the protoplasm called, if but few in number and relatively very long, flagella, and cilia if numerous and relatively short. These, by lashing the medium, propel the animal, or, if anchored, drive currents past the aperture; whilst in the highest divisions the cilia are replaced by styles or setæ which act very much like walking organs, and in the still more highly endowed tentaculifera the prehensile prolongation of the body substance is tubular; usually with sucking disc at the extremity, and often with a spiral coiled fibre for its retraction.

A still more highly specialized instance occurs in certain ones

of this group, in which the tentacles become marvelously flexible; this is notably the case in Ephelotida and in *Podophyra flexilis*, a fresh-water species described by myself in THE MICROSCOPE for August, 1887. In this form the long, extensible and constantly writhing arms remind one of a veritable octopus.

Another equally instructive series is that of the manner of and contrivances for food ingestion. In the simplest forms this takes place by simply engulfing it; a little higher in the series it is received through the body walls at restricted areas; then a well-defined and guarded aperture is found, often reinforced by a wonderfully complex system of chitinous or otherwise indurated appendages, or it may consist of sucking tubes, sometimes flexible. But enough of these details, which have been enumerated not only to show the mutual relatives of the groups which result from the fact of descent from common ancestors, but to present certain terms by which to make easy the explanation of the persistency of protozoic functions in the associated cells of the tissues of multicellular animals; thus the amœboid motion of the colorless blood-corpuscles and other cells, the contractions of the muscle cells, the cilia of the epithelium of the trachea and ventricles of the brain are examples.

The protozoa, lowly as they are in organization and insignificant in size, have from the dawn of animal life on the earth to the present, played a leading part in the great problems and progress of the world. Biological evidence is irresistible in proof that the first manifestation of animal life was protozoic; that the capabilities of development on this type were finally exhausted, and that there radiated from the protozoic line at different stages, certain metozoic types. All through the ages of change they have kept persistently to their work. The heat and drouth of summer or the frosts of winter cannot destroy them; when the water of the transient streams disappears or food fails, they simply wrap about their frail bodies an impervious mantle, to retain their own moisture, and fall asleep until returning favorable conditions restore them to activity; then again the battle of life goes fiercely on beneath the surface. Each feeds ravenously upon unicellular plants or mercilessly on those of its kind smaller than itself, and, in turn, is destined to be swallowed by one that is larger. Notwithstanding this inevitable destruction, their prodigious powers of multiplication and reproduction ever maintain them against the vicissitudes of climate or the distress from enemies. This invisible link, uniting the animal

to the vegetable, and this to the mineral, incessantly at work, is found everywhere that moisture abounds.

Saville W. Kent has gracefully said: "Inappreciable individually to the unaided vision, the countless hosts of the infusorial world, more familiar, perhaps to the popular mind under the designation animalcules, or animalcula, surround us literally on every side. They abound in the full plentitude of life, alike in the running stream, the still and weed-grown pond, or the trackless ocean. Nay more; every dew-laden blade of grass supports its multitudes, while in their semi-torpid, encysted or sporalar state they permeate as dust the atmosphere we breathe, and beyond question form a more or less considerable increment of the very food we swallow."

But it is not altogether the invisible and theoretical that challenge our attention and admiration. Mountain masses of limestone are their enduring monuments. From the warm seas of remote geological ages to the cooler seas of the present, they have been separating from sea-water the carbonate of lime, and fixing the carbonic gas, until it is manifest that they have done more than all other life towards preparing the present state of the modified crust of the earth. At the same time, they have recorded, in the rocky volumes by their entombed shells, much of the history of the past.

This society of microscopists has, from the first, kindly received, discussed and published contributions to our knowledge of the various groups of the simplest plants and animals; hence, it seems appropriate to briefly enumerate some of the chief problems, pertaining to the protozoa, which are open to us for investigation, problems to the solution of which the future work of the Society should contribute. Obviously, the first work to be accomplished by American students of the group, are the identification of the species, naming, describing and figuring the new species and genera, recording the distribution and habitats, and the presentation of the same in available publications. It is with pleasure and pride that we justly claim that in these lines the work is going forward vigorously, although the number of students is limited and, thus far, almost exclusively restricted to fresh-water and parasitic forms. The results already recorded plainly show that the protozoic fauna of our inland waters is extremely rich, presenting many characteristic and peculiar species. Many of our numerous species are undoubtedly identical, or differ but slightly from European species, so slightly that I have not considered them of specific value, whilst many more are perfectly

distinct. Dr. A. C. Stokes, who has described more of our species than any one else, has said that the species in the sphagnous swamps of New Jersey are mostly new. The many unique forms he has brought to light appear to justify the conclusion. There remains to be explored the waters of our extensive coast and the greater part of our vast inland waters. When this has been accomplished as thoroughly as it has been done in Europe, the number of species in the catalogue will be enormously increased. Then, again, there are whole groups which have well-nigh escaped observation; for example, the *Proteomixa*, of Lankester, a group at the very threshold of organic life, studied by leading biologists of Europe, but almost wholly neglected or overlooked in this country. A few of the species have been discovered, but aside from the additions by Dr. Joseph Leidy, scarcely any new data have been added to the recorded knowledge of the branch. Dr. Leidy has given us, in *Rhizopods of North America* (1879), an admirable summary and treatise of the rhizopoda, which, with the available manuals and reports, give our students of the rhizopoda a fair basis for work. In the field of infusoria there is equal advantage afforded by the manual of Kent, the magnificent treatise of Stein, the comprehensive work of Bütchli (now issuing), the paper of Entz, Maupus and others, and the recent summary of American species, both described and identified, by Dr. Stokes. So, at last, the books necessary for progress are to be had by our students; we have the microscopes surpassed by none; what, then, is lacking? Methods and determination that enters the mind as an influence. Our university biological laboratories do very little in this line, the ordinary schools, nothing; therefore, zoological stations, summer biological schools, and scientific societies may justly be called upon to foster this department of research by teaching its methods.

The discovery and description of species, although necessary and naturally first in order, are not the most important or most fascinating parts of the investigation. The biological history and habits of species, their food and relations to other species, are not less worthy of the student's attention. There are still many unanswered questions as regards their anatomy and physiology. Among these may be mentioned the following: the nature, behavior and significance of the nucleus, the nervous system, the reticulation of the protoplasm, pholophytic nutrition, the nature and action of the trichocysts, the passage from host to host of parasitic species and their pathological influence, the nature and function of the contractile vacuole, the production of shells and cysts, and many more.

I can not consent to close without alluding to the excellent work of American students of the protozoa already to our credit. We all know Dr. J. W. Bailey as a pioneer in American microscopy; as one who acquired a high degree of excellence in the microscope and was able to obtain from it its very best performance, and who did much toward fixing a high standard for our opticians and investigators. He was an industrious student of minute types of life, and the first, I think, to publish original observations on the protozoa in this country. His papers relating to these organisms occur in the Smithsonian Contributions to Knowledge, beginning in 1855. These consist of species identified, with descriptions of a few species of rhizopoda and infusoria. In connection with the first list is also one by Thomas Cole. Dr. Bailey remarks that "Mr. Cole is, I think, the first in this country to make a systematic study of the soft-skinned infusoria." Both lists contain the names of species which are among our most interesting ones.

Undoubtedly, the most brilliant discovery thus far stands to the credit of Prof. H. J. Clark. He was a student and, I think, an assistant, of Prof. Agassiz; hence, necessarily, a thorough investigator. Not feeling satisfied with the performance of the objectives made for Prof. Agassiz by Oberhaeuser, and the best to be obtained of that maker, he secured those by C. A. Spencer and R. B. Tolles. With these he was able to demonstrate structure in the protozoa not previously suspected. I refer, principally, to the discovery, in 1868, of the "collar of certain flagellate monads." This was a triumph for American objectives as well as for an American naturalist. The many beautiful forms discovered in the last two decades now constitute the order coano-flagellata. He also discovered at this time that the tubular passages of sponges were lined with similar collared monads; hence, he announced the protozoic nature of the porifera, a proposition with which but few naturalists at present accord. This is mainly, it seems, because the supposed embryology of the sponges allies them to the metazoa.

If these phenomena are finally interpreted differently, the sponges may yet be relegated to the protozoa. So far as the fresh-water representatives are concerned, excepting the so-called embryological characters, they appear to be protozoic; especially since the discovery of proterospongia, a genus of undoubted coano-flagellate monads which secrete a mucilaginous matrix for the shelter of the colony. Representatives of the genus are known both in Europe and America.

The Monogroph of the North American Rhizopods, by Dr. Liedy, has been mentioned. Besides this excellent work, he has published many papers on rhizopoda, Gregarinæ and infusoria. Most of the infusorian species are parasitic in the intestines of insects and worms.

The foundations of the science are well laid; there are now greatly increased facilities for study, so that earnest specialists are now able to advance our knowledge of these forms rapidly and with credit to our science. I will omit further mention of specific work, reserving the same for an appendix to this article.

I am intensely interested in the lowly creatures to which I have asked your attention, and I hope they are not wholly devoid of interest to any of you. The exactions of the occupation of American school teachers leave comparatively little time or energy for private study or investigation. The few hours each week that I can get, I devote to the refreshing pursuit of natural science. It has come into my life as an influence, as it has to many others. It seems to me, and I am led to the conclusion by observation as well as experience, that the influence of no other specialty is so edifying. The protozoa have afforded me for the past two years the most available opportunities for that communion with nature that is both fascinating and satisfying. I can heartily recommend these beautiful objects, so wonderful in their simplicity to any one who seeks a special field of study.

In conclusion, I will quote a paragraph from Dr. Liedy, expressing beautifully the experience of every true fisherman:

"Going fishing? How often the question has been asked by acquaintances, as they have met me with rod and basket on an excursion after materials for microscopical study. Yes, has been the invariable answer, for it saved much detention and explanation. * * * No fish for the stomach, but as the old French microscopist, Jablet observed, 'some of the most remarkable fishes that have ever been seen;' and food fishes for the intellect."

SEPTIC INOCULATION.—Charrin and Roger (C. R. de la Societé de Biologie) find that the septic vibrion causes a local lesion in the dog, inocuous in character, which generally, but not invariably, confers immunity against a new inoculation. These conclusions coincide with those which have been attained by Chaveau and Arloing, regarding gangrenous septicæmia.

AN APPLIANCE FOR MAKING PHOTO-MICROGRAPHS WITH THE MICROSCOPE IN THE UPRIGHT POSITION.

SENECA EGBERT, M. D.

I WISH to call attention to a simple appliance, by means of which photo-micrographs may be made with the microscope in an upright position, and by the use of almost any amateur camera.

It consists of two short brass tubes, fitted to one another at right angles, and having fixed at their junction a right-angled, isosceles prism with its hypothenuse silvered, thus forming a perfect mirror.

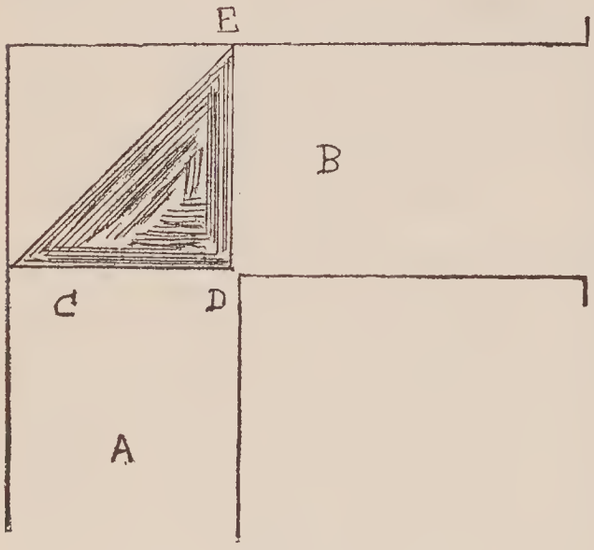

FIG. 1.

The vertical tube A should fit smoothly in the draw-tube of the microscope to be used, taking the place of the eye-piece; while the horizontal tube B should be large enough to receive the eye-piece in case it is desired to use the appliance as a camera lucida. If this prism-tube be slipped into the draw-tube of the microscope, it is evident that if the angle of the prism be exactly 90° and the sides true, the rays of light coming through the objective and striking upon the surface CD, will be reflected from the surface CE and pass through the tube B without distortion, whence they can be received upon the ground glass or dry plate of any camera that may be connected by a light-tight cone with the projecting end of the tube B.

Some of the advantages that may fairly be claimed for this appliance are:

a. Simplicity.

b. Absence of any vibration, either in microscope or camera. This is a serious objection to all devices for suspending or supporting the camera above the microscope.

c. The ability to photograph objects in fluid media; *e. g.*, the growth of crystals and of low forms of life (as the Amœba or Oscillatoria). I am even confident that, with sufficient light from a good heliostat, instantaneous photographs may be obtained of some of our moderately lively infusoria.

d. Its applicability to instruments which have no hinge and which cannot be tipped to the horizontal position.

e. Ease of manipulation, focusing, etc. With the camera extended so as to give an image two and one-half inches in diameter, it will be found that all parts of the microscope (stage, mirror, coarse and fine adjustments, etc.) can be readily reached and manipulated by the hands while the eye is watching the image on the ground glass. For greater enlargements, the focusing can easily be governed by cords and weights, as in the more expensive outfits. The ease with which the prism-tube and eye-piece can be substituted for one another prevents any difficulty in finding and fixing a desired field.

f. Almost any camera or light-tight box capable of receiving a dry-plate holder may be used, thus doing away with the necessity of a special camera box of extra length.

g. Cheapness, as compared with other means to the same end. The chief expense is in the prism, which must be both clear and accurately ground. A plane mirror, fixed in the plane CE (Fig. 1), would lessen the cost considerably, but the image given would not be so clear, on account of the unavoidable halation and double reflections from such a mirror. It may be well to state here that, unless the prism is the full size of the vertical tube A, it will be necessary to insert a diaphragm (with either round or square opening) in the tube A to shut off the rays of light that would otherwise pass between the sides of the prism and of the tube; and that, in this case, the field given in the image will be to the whole field seen through the eye-piece, as the area of the opening in the diaphragm is to the area of the tube of the microscope.

h. The appliance may be used as a camera lucida, with or without the eye-piece, by simply tipping the microscope to the horizontal position.

The objections that may be urged against the appliance are: That the illumination is by reflected, instead of direct, light; and that the rays lose some of their actinic power in passing through the prism. I think that the combined disadvantages arising from the above will be found to be theoretical rather than practical, and that they can be fully counteracted by exposing the plate a second or two longer. In fact, I have over-exposed plates in three seconds, using unconcentrated sunlight for illumination and a Zentmayer eight-tenths objective (no eye-piece).

Figure 2 will show how the camera to be used may be brought up to the same level as the projecting end of the prism-tube. The platform should be of such a height that the image is centered on

the ground glass of the camera when the objective of lowest power is used. Then, when higher powers are used, the prism-tube and image are kept at the same level by simply drawing out the draw-tube of the microscope for a short distance.

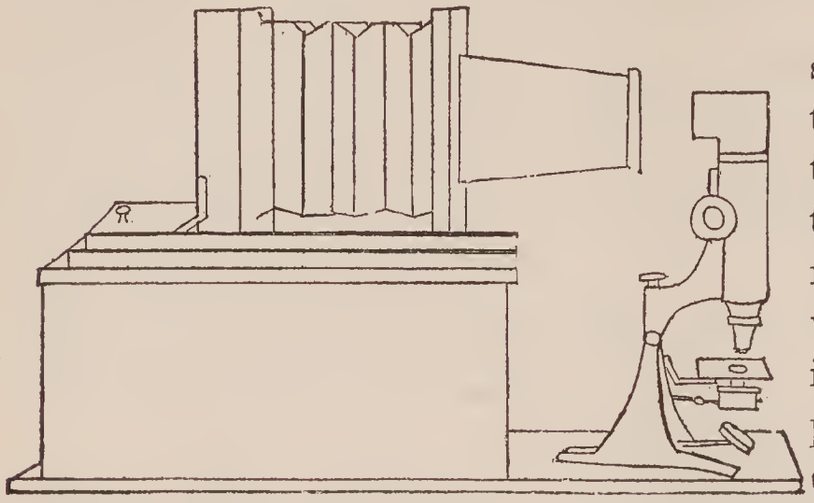

FIG. 2.

The projecting cone seen in Fig. 2, attached to the front-board of the camera, is made of tin, may be of any reasonable length, and will cost but a trifle. It is connected to the prism-tube by a cloth cap, which permits the slight motion needed in focusing with both coarse and fine adjustments.

Since writing the above, I have been told by Mr. Zentmayer, Jr., that after receiving my order (about April 15th), he received designs from, and made a somewhat similar appliance, for Mr. J. C. Boyce, of Pittsburgh, Pa.

If I am not mistaken, it was used at the exhibition of the Pittsburgh Microscopical Society, May 25th, with a binocular stand, to allow two persons to observe the same object at the same time; the visitor looking through the appliance at one side, while the exhibitor, using the other tube of the microscope, managed the focusing, described the object, etc.

PHILADELPHIA, PA.

EDITORIAL.

SUB-STAGE CONDENSERS.

WITH the low-angled objectives of a few years ago, a sub-stage condenser was an indispensible accessory for work with high powers. As the aperture of objectives increased, the demand for sub-stage condensers diminished, and they were but rarely used. The stimulus that has been given to working with high-power by bacteriological discoveries, and the necessity in the study of bacteriology of adjunctive high illumination, has again made the subject of sub-stage condensers one of great importance. Although the objective or eye-piece adjusted to the sub-stage, the Wenham button, and others, have served a good purpose, they are inadequate to the

demand of the present time. This demand has developed the large, wide-angled condenser of Abbé, and this accessory has become indispensible to advanced histological research, and with which may be accomplished almost all the various illuminating effects. The field of light it gives is so soft, even and controllable, that it must in the future replace all other sub-stage illuminators.

The apparatus consists of two non-achromatic lenses, mounted in a short tube. The upper lens is plano-convex, and is greater than a hemisphere; when properly adjusted, its plane surface lies slightly below the upper plane of the stage. The focus of the combination is only a few millimeters above the plane-surface of the upper lens, and is therefore very near to the object. The angle of aperture of the emergent rays is 120° in water, so that the marginal rays are inclined to the axis at an angle of nearly 60° in water. The extremely large size of the condenser admits all the light that can pass through the sub-stage. With such a combination, the light at the focal point is very intense—in fact, it is so great that all of it can be used only in certain examinations. Below the lenses is placed a ring adjusted by different mechanical devices by the various manufacturers, which, in its recess, receives diaphragms with various sized apertures. A diaphragm with central stop for dark-ground illumination, and one with an eccentric aperture for giving various grades of oblique light, accompany the apparatus.

The plane-surface of the upper lens is intended to be in homogeneous, immersive contact with the lower surface of the slide, but as the effect of this contact is merely to slightly increase the intensity of the light, which is often too great, it may generally be used dry.

To use the apparatus for ordinary histological examinations, the condenser should at first be placed close under the slide, and the light thrown into it from the *plane* surface of the mirror. Then, according to the intensity of the light required, the condenser may be racked down, and by experiment the diaphragm with the sized aperture to give the best definition. Experience only will give the operator skill in this adjustment.

For the examination of stained bacteria, the condenser should be left open. As we mentioned in a recent issue, the effect of the intense light thus given is to bring out in bold relief the stained bacteria, and make invisible the detail of the surrounding structure. As Koch terms it, it "isolates the stained image."

ACKNOWLEDGEMENTS.—From E. L. Smith, M. D., Bellefontaine, Ohio, photo-micrographs; from Prof. M. D. Ewell, Evanston, Ill., eye-piece micrometer scale; from Dr. J. E. Hays, Sweetsprings, Mo., micro-mounts; from J. G. Meachen, Racine, Wis., mount of pollen; from A. M. Hayward, Susquehanna, Pa., mounts of chloride of gold and sodium crystals; from M. S. Wiard, New Britain, Conn., diatoms from Peruvian guano.

IT is with great regret that we announce the death of Dr. E. P. Howland, of Washington, D. C., a man full of genius, but who, to use the language of a friend, "never got much credit for it."

DR. HOWLAND made some excellent improvements in methods of handling both calcium and electric light. At the last meeting of the Washington Microscopical Society, a few evenings since, a committee was appointed, consisting of Drs. Thos. Taylor and Reyburn, to draw up resolutions lamenting the loss of Dr. Howland, to be submitted to the Society at the next meeting. At the recent meeting at Cleveland of the A. A. A. S., Dr. Howland exhibited for the members many objects of interest, on the screen, with electric light.

TECHNOLOGY.

DEVICE FOR CUTTING OUT LANTERN SLIDE MATS.

JOS. P. BEACH, in *The Universal Tinker:* My method consists in taking a block of hard mahogany, apple-tree or pear-tree wood, with the end grain upward, and about an inch and a quarter thick, and as large in size as an ordinary lantern slide plate, and marking on the surface with a lead pencil the form and size of the mat wanted, but perhaps a little smaller than an actual size. Then, with proper tools, chisels and files, I take off the block, a half inch in depth, the wood, until it assumes the oval or square marked out. I back up the mahogany block with half an inch of a softer kind of wood, securing it by screws, and bore a hole through the center, three-eighths of an inch in diameter. This permits the air to reach the center. Around the wood form thus made, I bend an ordinary clock spring, which can be bought very cheaply, and is usually about three-quarters of an inch wide, and secure it to the wood by screws. I prefer to do this with the

aid of a vice, putting in one screw at a time, until the circuit is completed. The pressure of the vice holds the steel against the wood until it is fastened by the screw. Before the steel is bent around the wood, firm holes for the screws should be punched where needed with a blunt-faced punch, and be afterwards reamed out. Five screws generally answer. The steel should be laid on a piece of hard wood or block of solder for this purpose. If the spring is too hard to punch a hole through it, take out the temper by heating in a stove and cooling by throwing into a bed of ashes. It will be seen that the thickness of the spring, about one thirty-second of an inch, will be too great to cut the paper clean and sharp; hence I advise filing down one edge, the inner, before the steel is attached to the block. In putting it on, the ends should come close together; if they lap a trifle, they can afterwards be filed away. In shaping the spring around the block, a pair of pliers and a hammer will be of service. For making square shapes, a thinner steel, to be obtained of dealers in machinists' tools, will be found preferable to the clock-spring.

To cut out the mats, I simply fold a sheet of paper 8 x 10 in sixe until it is four layers in thickness, place it on the steel die, and then, having a piece of mahogany wood, with the end grain in contact with the paper, several quick taps with a hammer are given, and the mats are made.

NEW ARTIFICIAL FLUID FOR COUNTING BLOOD CORPUSCLES.—*The Medical News* takes the following from the *Wiener med. Pr.*, June 10, 1888: At the last session of the Paris Académie des Sciences, Mayet submitted a new artificial fluid for measuring the corpuscular elements of the blood. Four cubic mm. ($6\frac{1}{2}$ minims) of blood are mixed with 500 cubic mm. ($1\frac{2}{3}$ fluid-ounces) of a watery solution of osmic acid, and allowed to stand for three minutes. Then 500 cubic mm. ($1\frac{2}{3}$ fluid-ounces) of a mixture of 45 cubic cm. ($1\frac{1}{2}$ fluid-ounces) of pure glycerine, an equal quantity of distilled water, and 17 cubic cm. ($4\frac{2}{3}$ drachms) of a watery solution of eosin are added. The red corpuscles are colored red by this solution, while the white remain uncolored. By this means the counting is notably facilitated.

JAPAN WAX, which is advocated as an imbedding material, is obtained from the *Rus succedaneum*, a tree growing eight or nine meters high. The wax melts at from $53\frac{1}{2}°$ to $54\frac{1}{2}°$ C., and solidifies at 40.5° to 46.5°.

ABSTRACTS.

EDUCATING THE WHITE BLOOD-CORPUSCLES.

DR. RAY LANKESTER, in an address on "The Struggle for Life" (*The Hospital Gazette*), in speaking of the function of the white blood-corpuscles, said that the corpuscles could be educated to deal with the bacteria, and the future of preventive medicine would be the education of the white blood-corpuscles. The fact that one man, by constant use, could, without injury, take a dose of arsenic that would kill six ordinary men, was due to the fact that he had, by weakened doses, been educating and training the white corpuscles. They could be taught to eat and flourish under conditions which, if not commenced gradually, would be destructive to them, and that was the principle underlying protective inoculation. As a preventive of many fatal diseases in sheep and oxen, inoculation has been remarkably successful. The corpuscles first receive a weakened breed of disease by inoculation, and thus, when a violent attack came, they were ready to receive and dispose of it. This education of the corpuscles, it seemed to him, was the explanation of the success of vaccination. They received a weak dose of the poison from the vaccine, and were in that way prepared for a stronger dose in the way of small-pox. He believed the white corpuscles could be trained to receive the most virulent poisons, and he hoped this training would be carried on so as to deal with a great number of diseases.—*Science.*

HEREDITARY TRANSMISSION OF PARASITIC ORGANISMS.—Max Wolff (*Arch. f. path. An. u. Phys.*) studies the question of the passage of microbes from the mother to the fœtus. His experiments deal with the microbes of malignant pustule, vaccinia, small-pox and tuberculosis. The fœtus of the rabbit whose mother has been inoculated with malignant pustule, is not infected, and no trace of bacilli can be discovered by the microscope or by cultures. Wolff arrives at similar negative conclusions regarding vaccinia and variola. With tuberculosis, no affirmative results were reached. While transmission may be possible, he considers it rare. He especially warns us that the tubercular infection does not necessarily take place through the organs of respiration; children being especially liable to infection through eruptions and cutaneous abrasions.

PHOSPHORESCENT BACTERIA.—The property possessed by certain sea-fish, of being phosphorescent in the dark, is due to the presence on their surface, of micro-organisms, living there as parasites. These are short, oblong bacilli, easily isolated by Koch's method. They develop on gelatine which they do not liquify, if from two to three per cent. of common salt be added. They form excessively curious luminous colonies. By exposing the cultures to a temperature of 35° to 37° Centigrade, they soon lose their vital properties, and their serial reproduction becomes impossible. On the other hand, at a temperature of freezing they develop with manifest rapidity. (W. Œllinger, Revue des Sciences Medicales.)

MICROSCOPY OF THE UNITED STATES PHARMACOPŒIA.—In a recent paper by Prof. H. M. Whelpley, of St. Louis, the writer says: "The sixth decennial revision of the United States Pharmacopœia does not have much to say about the microscope, although the instrument is recognized more than it was in the previous revision. Among the eighteen principles adopted at the national convention for the guidance of the revision committee, we find the fifth to read as follows:

"'*Description of Crude Drugs.*—To all crude drugs of animal or vegetable origin, concise, but complete, descriptions are to be added, sufficient to indicate the physical characteristics visible to the naked eye, and, when necessary, such as are visible under an ordinary good pocket lense, magnifying about ten diameters. When external and visible properties are insufficient to characterize the substance properly (as in the case of gums, resins, balsams, etc.), it shall be further defined by the physical and chemical properties.'

"The following is a list of drugs of which the committee saw fit to mention the microscopic structure: Aconitum, anisum, apocynum, arnica radix, asclepias, aspidium, azedarach, bryonia, buchu, calamus, carum, cimicifuga, cinchona flava, cinchona rubra, conium, coriandrum, dulcamara, foeniculum, gelsemium, geranium, glycyrrhiza, hæmatoxylon, inula, jalapa, juniperus, krameria, lappa, menispermum, pareira, phytolacca radix, podophyllum, pyrethrum, quassia, quillaia, rheum, rumex, sanguinaria, sarsaparilla, senega, stillingia, sumbul, taraxacum and zingiber.

"In addition the above list of drugs, the following preparations come under the same rules for descriptions: *Hydrargyrum cum creta, massa hydrargyri.* In this case the microscope is employed negatively to prove the absence in place of presence of certain characteristics. A microscope whose magnifying power is limited to ten

diameters will answer most all purposes with the above drugs and preparations, but a higher power must be employed for the following: Aloe, amylum, gossyprum, kamala, lupulinum and lycopodium.

"Every druggist should provide himself or herself with a microscope, or magnifying glass, as they are commonly called. One that magnifies ten diameters can be purchased at prices varying from twenty-five cents to two dollars and fifty cents, according to the quality and style. An ordinary 'pocket magnifying glass' is very serviceable."

ANATOMY AND PHYSIOLOGY OF STINGING HAIRS.—Dr. G. Haberlandt has examined the structure of the stinging hairs in a number of plants. The main features show a great uniformity in the multicellular base, surmounted by the very large secreting cell. Below the silicified apex of the latter, the cell-wall is always very thin. In *Loasa paparerifolia* the brittleness is occasioned by the deposition, not of silica, but of calcium carbonate, and in *Jatropha stimulans*, by liquefication. In other cases the liquefied apex is partially or entirely wanting. The substance which gives the stinging properties to the fluid of the glands of the common stinging nettle, is not, as has been generally supposed, formic acid, which could not produce the effect in such small quantities. Dr. Haberlandt also states that the irritation must be produced by a fixed substance, since the dried contents of the gland will cause the ordinary effect of a nettle sting if introduced beneath the skin. He finds always in the fluid a substance which exhibits all the properties of an albumenoid. The substance which produces the inflammation is probably a compound of the nature of an unformed ferment.—*R. M. S. Journal.*

NUCLEUS IN FROG'S OVUM.—Dr. G. Thin describes conditions of the nucleus in the ova of *Rana temporaria* between the stages of division into four segments and that of the appearance of the morula condition. Sections were made from egg hardened in bichromate of potash and stained with picro-carmine. These methods were not such as to enable the nuclear network to be satisfactorily made out. In the first stage observed, or that of a "tablet-nucleus," an unformed substance was found infiltrating the yolk in certain parts of the segments. Then came the diffuse granular nucleus, in which minute yolk tablets were found in the carmine-stained nuclear area. In the homogeneous nucleus the nuclear substance stains homogeneously in carmine, has distinct boundaries, and no yolk tablets or pigments. The fourth stage is that of the shrunk nucleus,

in which a crescent-shaped, shrivelled, homogeneous substance represents the nucleus. Fifthly, simple holes were found which appear to correspond to the position of the nuclei. The author gives a short account of the division of the nucleus, of the pigment, and of the pigment in relation to the segment. Pigment has no causal relation in the nuclear changes.—*Jour. R. M. Society.*

VASCULAR BUNDLES OF ZEA MAYS.—Herr H. Potonié describes the development of the small anastomoses, which, in the leaves of the maize, connect the principal longitudinal vascular bundles transversely with one another, and points out the singular fact that the conducting tissue represented by the parenchyma-sheath of these anastomoses is of the same origin as the elements of the anastomosing bundles themselves, and differs in origin from the parenchyma-sheaths of the principal bundles, which are of a similar value from a physiological point of view.—*Journal Royal Microscopical Society.*

NEWS AND NOTES.

PROF. D. S. KELLICOTT, of Buffalo, has been appointed to the Chair of Biology, Ohio State University.

DR. ALFRED C. STOKES contributes to the June and July *Swiss Cross*, a very readable article on "An Old Dutch Microscopist" (Leeuwenhoeck), and what he did.

M. GRAND 'EURY has propounded a theory that coal was originally a liquid generated by the decomposition of inferior vegetation in an atmosphere highly charged with carbonic acid. The carbon of the jelly-like mass thus formed, after passing through various transformations, into asphalt, petroleum, bitumen, etc., finally assumed the form of coal. The author cites various facts connected with the occurrence of coal, which, he thinks, are better explained on his theory than by the usual one.—*Popular Science Monthly.*

BOOK REVIEWS.

THE MODERN TREATMENT OF DISEASES OF THE LIVER, by Prof. Dujardin-Beaumetz; translated by E. P. Hurd, M. D.

Another attractive volume of the "Physicians' Leisure Library" has just appeared from the publishing house of Geo. S. Davis, under the above title. The book is divided into seven chapters, each of which is complete in itself. To those who are interested in diseases of the liver, this little book will be welcome.

EXCHANGES.

This department is for the benefit of SUBSCRIBERS *who have microscopical apparatus, material or books which they wish to exchange, and such wants will be* INSERTED FREE OF CHARGE. *The number of insertions given will depend upon the number of exchanges received each month. Subscribers will please notify us when articles have been exchanged or sold. Dealers are referred to our advertising department.*

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VOL. VIII. DETROIT, NOVEMBER, 1888. No. 11

ORIGINAL COMMUNICATIONS.

THE FORM AND SIZE OF THE RED BLOOD-CORPUSCLES OF THE ADULT AND LARVAL LAMPREY EELS OF CAYUGA LAKE.*†

SIMON H. GAGE, B. S.,

AS the red blood-corpuscles of the camelidæ form an exception in the great mammalian group in being oval instead of circular in outline, and, according to Gulliver (3),‡ in not forming distinct rouleaux or rolls, so the red corpuscles of the lamprey eels form an exception in the great non-mammalian group of vertebrates (birds, reptiles and fishes) in being *bi-concave* and *circular*, instead of *oval* and *bi-convex*, like those of all the other animals in this great group. The corpuscles also agree with those of mammals in forming distinct rouleaux. This is most marked in the brook lamprey and the larva. In the 9 mm. embryo the corpuscles were often seen in rolls of three or four in the circulating blood. (Fig. E. F.) This has also been observed in the vessels of the dog's mesentery (19). A nucleus is present in all the corpuscles, but as it is small and placed in the thickest part of the corpuscle, it is not apparent in the perfectly fresh corpuscles, except faintly in some

* Following Jordan and Gilbert (Synopsis of the Fishes of North America, 1882), the adult lampreys are called sea lamprey (*Petromyzon marinus*) and brook lamprey (*Ammocœtes branchialis*). The name Ammocœtes was originally applied to the larval condition, supposing it to be a distinct animal and not merely a larva. All the specimens from which blood was taken were obtained in May and June in the streams flowing into the head of Cayuga Lake. The smallest larvæ (embryos 9 mm. long) were taken from the nest of the sea lamprey. The larger larvæ were dug out of a sand-bank along the stream; it is no known whether they are the young of the sea or of the brook lamprey.

† Transactions American Society of Microscopists, 1888.

‡ The numbers in parenthesis refer to the bibliography at the end of the paper.

of those of the 9 mm. embryo. The corpuscles when fresh appear, therefore, almost exactly like those of man. No element of uncertainty should arise with respect to them in legal medicine, however, for: (*a*), the presence of a nucleus may be readily demonstrated, as it is made apparent by drying, by acetic acid and by the reagents most used in examining blood for medico-legal purposes; (*b*), except in the embryo, 9–10 mm. long, the corpuscles are nearly twice as large as those of man. (Compare the accompanying table of measurements). Hence, the blood-corpuscles of lamprey eels, in spite of their bi-concave form and circular outline, really offer no more difficulty in medical jurisprudence than do the corpuscles of any other of the non-mammalian vertebrates.*

The circular outline for the red blood-corpuscles of both adult and larval lampreys was discovered by R. Wagner and the fact published in 1838 (18). The bi-concave character is remarked upon by Wagner, Kölliker and others, but I have seen no reference to the fact that the corpuscles form distinct rouleaux like those of mammals.

Although the bi-concave character of the corpuscles of lampreys is as easily demonstrated as in the corpuscles of mammals, it is stated by Gulliver and Günther (4 and 5) that they are flat or bi-convex, and Gegenbauer (2), in his Comparative Anatomy, states that the red blood-corpuscles of birds, reptiles, amphibia and fishes are bi-convex, no exception being made for the lampreys. Parker (15), in his translation of Wiedersheim's Comparative Anatomy of the Vertebrates, says: "In case of the red corpuscles, the nucleus persists, and the whole cell is bi-convex in all vertebrates below mammals." In 1887 wide circulation was given to a statement by Shipley (16) and Thompson (17), that the red blood-corpuscles of larval lampreys were oval in outline, like the rest of the non-mammalian vertebrates, and came to be circular only in the adult.

That the red blood-corpuscles of both the adult and larval lampreys inhabiting Cayuga Lake are circular, bi-concave, nucleated discs, as described and figured in this paper, was repeatedly demonstrated in larvæ from 9 to 142 mm. long, and in numerous adults. In every specimen examined all the corpuscles not irregular were circular in outline. To make sure that this appearance was not due to reagents, the corpuscles were examined in the serum of the blood, without the addition of any reagent whatsoever, and to avoid any possible error on account of the small amount of blood in the 9 mm. embryo, the circulating blood was examined. All the

* While it is true that the red corpuscles of mammalian embryos and the developing corpuscles in the adult are nucleated, the size and uniformly nucleated condition of the corpuscles of the lamprey would sufficiently characterize them.

examinations were made with a 2 mm. apochromatic objective and an ocular ×12.

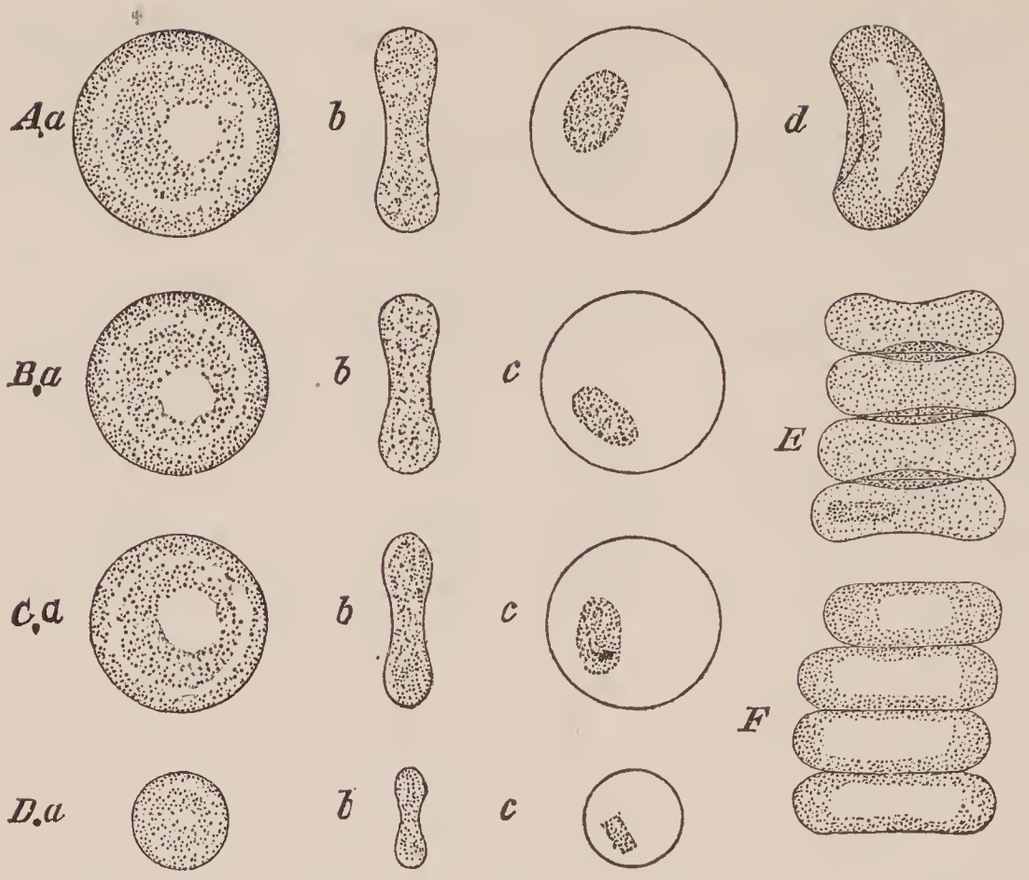
That the corpuscles should be circular in the larva as well as the adult is to be expected also on morphological principles, for as far as investigated the red blood-corpuscles of all vertebrates, mammalian as well as non-mammalian, are at first circular in outline, and become oval, if at all, only at a later stage of development. (12, 8, 10.)

Table showing the diameter and thickness of the red blood-corpuscles of lamprey eels in the adult and larval condition; also the relative number of red and white corpuscles, and the number of red corpuscles in a cubic millimeter of blood.*

	DIAMETER.			Thickness.	Ratio of thickness to diameter	Ratio of white to red corpuscles.	Number of red corpuscles in a cubic millimetre.
	Maximum.	Minimum.	Average.				
Petromyzon marinus	16.16 μ	10.1 μ	14.2 μ	5.05 μ	1 :2.8	Male, 1:20 Female, 1:15	Male, 391,333 Female, 334,666
Ammocœtes branchialis	15.15 μ	10.1 μ	13. μ	5.02 μ	1:2.59	1:95	500,000
Larval lamprey 142 mm. long,	15.65 μ	12.12 μ	13.4 μ	3.48 μ	1 :3.8	1:10	Not determined.
Embryo lamprey, 9 mm. long,	8. μ	7. μ	7.448 μ	1.96 μ	1 :3.8	1:10	Not determined.

NOTE.—The blood for measurement was taken from the heart or a pithing wound, and mounted without the addition of any liquid. The cover-glass was supported by a hair, and sealed with castor oil. Only undistorted corpuscles were measured. The averages were obtained from twenty-five measurements in each case. All measurements were made with a 2 mm. apochromatic objective and C. ocular containing a Jackson ocular micrometer, the value of which was determined by using a Rogers standard stage micrometer.

*In a larva 73 mm. long, the average diameter was 12.44 μ—that is, 0.96 μ smaller than in the larva of 142 mm. given in the table. Gulliver (4, p. 845) states that "there is little difference between the blood-corpuscles of *Petromyzon planeri*, *P. fluviatilis* and *Ammocœtes branchialis* [the larval form]; that one description may serve for all three of them;" and gives the following measurements: Diameter of the red corpuscles, 11 9 μ; thickness, 4.09 μ; diameter of nucleus, 3.96 μ. Kölliker (9) gives 11.3 μ as the size, not mentioning the species or the age. Welcker (20) gives 15 μ as the average size of the red corpuscles of *Petromyzon marinus*, with a maximum of 16 μ and a minimum of 13.4 μ. Thickness of the corpuscles, 3 μ. For the larva the average is 11.7 μ, with a maximum of 12.4 μ and a minimum of 10.9 μ. Thompson (17) gives the size of the red corpuscles of *Petromyzon marinus* as 13 μ to 14 μ. He says also that the number of white corpuscles is three or four times as great as the red ones. Welcker gives the number of red corpuscles in a cubic millimeter of the blood of *P. marinus* as 133,000.



Figures of the red blood-corpuscles of adult and larval lamprey eels, showing the appearance in different positions and the relative size in the different animals. Magnified 1 000 diameters. Outlined with Abbe's camera lucida. Drawn by Mrs. Gage. From the *New York Medical Journal.*

A. Red blood-corpuscles of the sea lamprey (*Petromyzon marinus*). *a*, face view of a corpuscle; *b*, optical section of a corpuscle on edge; *c*, face view of a corpuscle, showing the nucleus after the action of one per cent. acetic acid; *d*, cup-shaped corpuscle.

B. Red blood-corpuscles of the brook lamprey *(Ammocœtes branchialis)*. *a*, *b*, *c*, the same as in A.

C. Red blood-corpuscles of a larval lamprey 142 mm. long. *a*, *b*, *c*, as in A.

D. Red blood-corpuscles of a larval or embryo lamprey 9 mm. long. *a*, *b*, *c*, the same as in A.

E. Rouleaux of the corpuscles of the brook lamprey in optical section. In the lower corpuscle a nucleus is indicated to show that it is small and in the thickest part of the corpuscle. It is visible only after the hæmoglobin is partly or wholly removed from the corpuscle. In the embryo, where the corpuscles are so small, the nucleus is faintly visible in many corpuscles before the removal of the hæmoglobin.

F. Rouleaux of the 142 mm. larva focused on the upper surface. In both E and F the corpuscles are shown of different sizes. Compare the maximum and minimum diameters in the table of measurements.

ANNOTATED BIBLIOGRAPHY.

1. *Gage, Simon H.*—The Red Blood-Corpuscles of Lamprey Eels in Relation to Jurisprudence. *New York Medical Journal*, Vol. XLVIII (1888), pp. 149–150. The main facts of the present paper were given.

2. *Gegenbauer, C.*—The Elements of Comparative Anatomy. London, 1878. "In fishes, amphibia, reptiles and birds, they [the red blood-corpuscles] are oval and *bi-convex*, for the center of each surface protrudes slightly." p. 576.

3. *Gulliver, G.*—The Works of William Hewson. London, 1846. Note CIX (p. 228), non-formation of rouleaux by the red corpuscles of the camels. Note CXVII: "In the cyclostomes the corpuscles are of the same figure as those of man's, and only

slightly larger." See under 13 for the oval form of the corpuscles in myxine.

4. *Gulliver, G.*—On the Red Blood-Corpuscles of Vertebrates. Proceedings Zoölogical Society, 1862, p. 99; 1870, p. 844; 1875, p. 474. Gives an excellent account of the blood-corpuscles in all groups of vertebrates, and says (1870, p. 844): "The red corpuscles of the lamprey are but rarely or exceptionally bi-concave discs, and then only from irregular or unequal depressions on the surfaces, scarcely ever from two symmetrical concavities. * * * On the contrary, the red blood-corpuscles of the lamprey are regularly either flat or slightly bi-convex." This characterization does not hold for the corpuscles of the American lampreys examined. The red corpuscles are many of them distorted, however.

5. *Günther, A. C. L. G.*—An Introduction to the Study of Fishes. Edinburgh, 1880. In this and the following it is stated that the corpuscles of lampreys are flat or *bi-convex.* "The blood-corpuscles of fishes, with one exception, are of elliptical shape; this exception is *Petromyzon*, which possesses circular, flat or slightly bi-convex blood-corpuscles."

6. *Günther, A. C. L. G.*—Article, Ichthyology, Encyclopædia Britannica, 9th ed., vol. 12, p. 658.

7. *Huxley, T. H.*—A Manual of the Comparative Anatomy of Vertebrated Animals. New York, 1873. The red blood-corpuscles in the marsipobranchii are circular and nucleated. All other fishes have oval corpuscles. p. 90. See under 13 for myxine.

8. *Jones, Wharton.*—The Blood-Corpuscle Considered in its Different Stages of Development. Philosophical Transactions, 1846. Says the blood-corpuscles of lampreys are circular at all stages of development. p. 66.

9. *Kölliker, A.*—Handbuch der Gewebelehre des Menschen. Fünfte umgearbeitete Auflage. Leipzig, 1867. Also, his Manual of Human Histology, translated and edited by Busk and Huxley, 1853–4. Says, p. 629, German, Vol. II, p. 336, English, that the corpuscles of petromyzon and myxine are circular and bi-concave. See under 13 for myxine.

10. *Kölliker, A.*—Grundriss der Entwickelunsgeschichte, 2nd ed., 1884. Says corpuscles of the chick are, in the course of development, first circular. p. 63.

11. *Leydig, F.*—Traite d' Histologie de l' Homme et des Animaux. Paris, 1866. Says, p. 507, that the red corpuscles of myxine and petromyzon are circular and bi-concave. See under 13 for myxine.

12. *Milne-Edwards, H.* — Leçons sur la Physiologie et l' Anatomie de l' Homme et des Animaux. 14 vols. Paris, 1857-1880. Says, in Vol. I, p. 62, that only the circular corpuscles form distinct rouleaux. In the corpuscles of all non-mammalian vertebrates, the corpuscles are, in the course of development, at first circular, probably circular in the Camelidæ also, p. 48.

13. *Müller, J.*—Untersuchungen über die Eingeweide der Fische. Abhandlungen der Kgl. Akad. der Wissenschaften zu Berlin, 1843, pp. 109–170. In this paper is announced the discovery that the red corpuscles of myxine are, in the adult condition, oval, while the developing corpuscles are circular, p. 119. The statement is so important, in consideration of the statements by many comparative anatomists, that it is here given : "Die frische untersuchten Blutkörperchen der *Myxine glutinosa* sind elliptisch, platt wie gewöhnlich und mit einem rundlichen Nucleus versehen, dessen Oberfläche ein granulirtes Ansehen hat. Die jüngeren Blutkörperchen geben sich durch ihre blassere Farbe und ihren runden Umfang zu erkennen."

14. *Owen, R.*—Comparative Anatomy and Physiology of Vertebrates. 3 vols. London, 1861-1868. In Vol. I, p. 463, he says: "Corpuscles nearly circular in the lamprey and ammocœtes (that is the larva); in myxine they are elliptical."

15. *Parker, W. N.*—Elements of the Comparative Anatomy of Vertebrates: adapted from the German of R. Wiedersheim. London, 1886. It is stated that the red corpuscles of all vertebrates below mammals are *bi-convex*. The corpuscles of cyclostomes are circular, p. 268. See under 13 for myxine.

16. *Shipley, A. E.*—On Some Points in the Development of *Petromyzon fluviatilis*. *Quarterly Journal of Microscopical Science*, Vol. XXVII (1886–7), pp. 325–370. "The blood-corpuscles are of only one kind, large, oval, disc-like structures, with a well marked nucleus," p. 343.

17. *Thompson, D'Arcy W.*—Note on the Blood-Corpuscles of the Cyclostomata. Ann. and Mag. Natural History, Vol. XX (1887), pp. 231–3. Anat. Anz. Bd. II, pp. 630–632. Repeats the statement of Shipley that the corpuscles of the larva are oval, and adds: "But the noteworthy point now is, that myxine possesses red corpuscles similar to those, not of the adult, but of the larval lamprey, which in many ways it resembles otherwise." As all observers, except Shipley, find the red corpuscles of lampreys at all ages circular in outline, any morphological conclusions like the above do not seem of extreme value.

18. *Wagner, R.*—Beitr. zur Vergleichenden Physiologie. Bd. ii, 1838. Nachträge zur Vergl. Physiol. des Blutes, p. 13. First announcement that the red blood-corpuscles of adult and larval lamprey eels are circular and bi-concave.

19. *Weber et Souchard.* — De la Disposition en Piles qu' Affectent les Globules Rouges du Sang. Arch de Phys. Normal et Path. 1880, p. 521–531. Figures and describes rouleaux in the vessels of the mesentery of a living dog.

20. *Welcker, H.*—Grösse, Zahl, Volum, etc., der Blutkörperchen. Zeit. F. Ratl. Medicin, 3d Reihe, XX Bd. See note to table of measurements, above.

CORNELL UNIVERSITY, ITHACA, N. Y., AUG., 1888.

NOTES ON THE DIATOMACEOUS FORMATIONS OF VIRGINIA IN CONNECTION WITH SOME RECENT DISCOVERIES MADE IN THE EXCAVATION OF THE EIGHTH STREET TUNNEL AT RICHMOND.

C. L. PETICOLAS.

THE Richmond beds underlie perhaps one-half the area of the city, and are found at depths varying from a surface exposure on the slopes of the hills to fifty or more feet beneath at their summits. Their actual extent at this point is about two and a half miles from north to south, by one and a half from east to west. At some points—notably on Broad street—the infusorial is overlaid by beds of stiff blue clay containing many casts of Miocene fossil shells, while at other places, and indeed for the most part, it is only capped by a stratum of ochreous earth from two to eight feet thick, containing Miocene fossils and the gravels, sands and clays of the Quarternary —the Pliocene strata not being shown at Richmond at all.

Dr. Ruffner, late Superintendent of Public Instruction in Virginia, informed me, that on the road between Richmond and Tappahannock, about forty-five miles to the north-east, this deposit crops out in many places, occupying everywhere the same geological horizon. My own observations at Petersburg, twenty-two miles south, and Wickham's, about the same distance north of Richmond, agree with his, so that we may with confidence refer to the whole of this great formation to the latter part of the Miocene Tertiary age. The lower parts of the stratum usually rest conformably upon beds of dark blue sands and clays, under which lie the Jurassic strata;

while beneath all are the primitive formations, gneiss and granite, which here form the bed of James River from Mayo's Bridge up. The richest, *i. e.*, the most purely diatomaceous part of the deposit, lies somewhat below the middle of the stratum and is not more than two or three feet thick; above and below a gradually increasing admixture of sand and clay finally obliterates the diatoms. On one slide of the smaller forms taken from the richest layer, about 70 distinct species have been noted, and the whole number probably largely exceeds Ehrenberg's calculation. In all the other Virginia diatom fields which I have examined, except the one at Petersburg, these forms appear to have been much injured by chemical action, and the number of species is smaller. A noteworthy fact is, that while the elevation of the coast line has been so extensive and gradual as to preserve the conformity of the strata (the diatoms now lying as they were originally deposited), the whole stratum is traversed by seams of a slate-like iron deposit from one-eighth inch to two or three inches in thickness at various angles to the plane of cleavage, as if some magnetic force had concentrated the iron which these organisms are known to secrete, to the total exclusion of the diatoms. Towards the edges of the field, where the deposit thins out from its ordinary thickness of twenty or thir y feet to a few inches, the diatoms are again lost. Repeated examinations of many specimens of earth from these points, having every characteristic of the diatom earth except its low specific gravity, have uniformly failed to show anything but fine sand and clay.

The City of Richmond is bisected by the valley of Shockoe Creek, about one-fourth of a mile wide, and it is in this valley, on the flanks of the hills and in the ravines making into it, that we find the infusorial deposit which occupies a plane at the city about ten or fifteen feet above the stream. Beyond the corporation to the north, a branch of the creek cuts through the stratum for half a mile. While the general character of the deposit is the same, certain variations in the species shown on opposite sides of this valley lead to the inference that the principal features of the land were shaped to some extent before it emerged from the water. As before stated, the characteristic forms of the Richmond diatoms are the same all over the field; but the relative proportions of the species vary in every locality. At a point in the Howard's Grove Valley *T. Marylandica* is so abundant that over one hundred specimens can be found on one slide; the same abundance of this form is shown in specimens from the Eighth Street Tunnel, but not elsewhere. A little way

down the valley the same sort of preponderance was shown by *Cos craspedodiscus.*

In March, 1876, a fragment of diatom earth was found rolling in the tidal refuse some miles south-east of Santa Monica, Cal., by Mr. T. P. Woodward. There was no sign of any diatom deposit in the vicinity. On examination this was found to be exceptionally rich in all the finest diatoms of the Pacific Coast. Subsequent researches have failed to bring to light another specimen of equal richness and beauty, although several have been found which approximate it. It seems probable, therefore, that the same variations occur in both of these great marine deposits, and that a duplication of exceptionally rich specimens is hardly to be expected. For two months past the Richmond and Chesapeake Railroad Company have been cutting a tunnel on Eighth Street, which will run directly through the diatomaceous stratum. After a great many examinations of the earth brought to view, several specimens have been found bearing nearly the same relation to the ordinary deposit as the Santa Monica find does to other California deposits of fossil diatoms. In one or two of these the small forms (mostly Synedra) are concentrated in minute pockets, from which, if carefully removed, they may be mounted pure and clean without any treatment. A series of five slides prepared from this earth shows abundantly the following beautiful forms, which are exceedingly rare elsewhere at Richmond, viz : *Aulacodiscus crux*, *Asteromphalii*, large and fine, equal to St. Monica, *Eupodiscus argus*, *Tric tridactylum* and *T. Marylandica.* There are also occasional specimens of *Coscinodiscus sol*, *Climacosphenia moniligera*, *Tric Balearix*, five-pointed, similar to the South American variety, *Eupodiscus*, supposed to be a new species, and a beautiful variety of *A. Crux* with five processes, one form, closely resembling the ancient grain mills dug out at Pompeii, I cannot classify. A minute fragment of the earth taken from a dump gives a most extraordinary showing of the large forms, especially *Cos gigas*, one of the finest of the Richmond diatoms.

These interesting results having been obtained by the examination of two or three dozen slides, it would seem reasonable to hope that the further study of this new material will considerably enlarge the catalogue of Richmond diatoms. Diatoms thrive best in clear, still waters, and the cold of Arctic and Antartic seas seems favorable to their growth. It is evident from examination of the Virginia deposits that currents contaminated with sand and mud eventually destroy them. It would therefore seem fair to argue that an Arctic

climate prevailed in the latitude of Virginia when the richest portion of this deposit was laid down. Mr. Henry Woodward, in the *Popular Science Review* for 1877, says: "In Eocene Tertiary tissues sub-tropical conditions prevailed in the latitudes of London and Paris. * * * Since that period, through Miocene and Pliocene formations, we trace a gradual lowering of the temperature by the sub-Arctic and Arctic character of the fauna and flora. *Then* came the *glacial period.* The axis of the earth has an inclination to the plane of its orbit of $23\frac{1}{2}^{\circ}$, and it is calculated to have reached an inclination of $35\frac{1}{2}^{\circ}$ during the glacial period, which Mr. Belt estimates to have occurred twenty thousand years ago, and Mr. Croll two hundred thousand."

It appears, then, that this most interesting deposit is a memorial of the glacial period; and, whichever calculation we adopt, its immense antiquity is evident. Looking through the tube of the microscope at these fairy forms flashing with all the brilliance and color of the richest gems, sculptured with geometrical lines more delicate and beautiful than the finest embroidery; remembering that for untold ages they have been compressed to solid rock under the superincumbent weight of millions of tons of earth, sand and gravel, we can but wonder at the almost miraculous preservation of so splendid an evidence of the "promise and potency" of the mysterious forces which surround us.

NOTES ON PRACTICAL EXAMINATION OF MUSCLE FIBERS.

V. A. LATHAM, B. SC., F. R. M. S.

SEEING the excellent article on the Forms, etc., of Muscular Fibers in the September number, I thought this collection of methods of examination might prove acceptable to those who wish to try the various ways and thus arrive at the best results. No originality is claimed, as the methods are those collected from various sources for some years, in some cases being considerably modified to suit my own requirements.

1. Harden the tissue by 95 per cent. alcohol; follow with absolute alcohol; cut sections, or tease the fibers carefully. Place the sections for one minute in 25 per cent. alcohol soaked for five minutes in Woodward's borax, carmine solution; then soak for about ten minutes in alcohol, acidulated with 20 per cent. of H. C. L., until the carmine is nearly removed from all parts except the nuclei;

wash in alcohol for a few minutes, the solution being changed until free from acid; then place for one-half to one minute in an alcoholic solution, $\frac{1}{12}$ gr. of picric acid to ℥ j; wash in alcohol, and transferred through absolute alcohol and clove oil to balsam; then finish.

2. *Eosin* method. Place the sections in a solution of eosin, one part to 1,000 of water, for a minute or two, then for a very short time in water slightly acidulated with acetic acid; then mount in glycerine or Canada balsam. I would recommend the *Lissotriton punctratus* (smooth skin newt) and the *Amphiuma tridactylum* as the best subjects for the above methods, as the muscular fibers, especially of the tongue, being particularly beautiful, the transverse striæ being very well marked and the nuclei very large in both species, and greatly elongated in Amphiuma, stretching about one-third across the field with a one-fifth objective and A ocular.

3. Double-straining with indigo carmine and carmine. In this method, if only the operator could be sure of the result, he would have a beautiful and useful stain. The specimens, if hardened in chromic acid, must be deprived of it by washing, and then immersed in the mixed dyes for a quarter of an hour; then transferred to a saturated solution of oxalic acid, both to "set" the blue color as well as to lighten the general tint; and then, having been washed in the distilled water, mount in C. balsam. The stain is made thus: *a.* A boracic solution of carmine (carmine, ʒ ss; borax, ʒ ij; distilled water, ℥ iv). *b.* A similar solution of indigo-carmine (Carmine ʒ ij; borax ʒ ij; dist. water, ℥ iv). Indigo carmine is the trade name for sulphindigotate of potassium, as used by Chrzonozczewsky in his researches upon the commencement of the portal duct. As a general dye, the blue boracic solution of indigo-carmine by itself is good and it stains rapidly. In using the double-staining for vegetable tissue, or even animal, the color is more permanent, I find, if the specimen is immersed in benzine after being in clove oil. In specimens of the liver the portal canal can be seen splendidly; the blood disks in the portal vein are of a brilliant apple-green, the hepatic artery reddish-blue, the process of clisson's capsule blue, or blue-purple; the wall of the portal duct is of the same color, but of a different tint, the columnar cells lining it being just tinted a brownish-purple with blue. In a specimen showing ossifying cartilage the component parts are of various colors and sharply differentiated. In ecchymosis of the skin the epithelium, as well as the connective tissue, are colored red, blue, purple, etc., while the extravasated blood cells between the fibers and fat cells are of a vivid green.

4. Fresh muscle should be treated with alcohol, or osmic acid (weak solution), and prepared in glycerine. When studying the phenomena of contraction, the muscle should be examined either in living insects or in recently removed parts immersed in blood serum or some albuminous fluid (white of egg, *e. g.*), or in glycerine; but never in water.

In insect muscle preserved in spirit, especially if the insect has been dropped while living into the spirit, the varying state of contraction of different elements of the same fiber may be seen just as fixed at the time of death.

5. Non-striped muscle.—Make a preparation of the mesentery of newt or salamander in chromate of ammonia (5 per cent.), that is, ℥ j. of salt to ℥ xx. aquæ, and mount in glycerine. Double strain with picro-carmine and logwood. To see the intercellular substance, take a small longitudinally cut portion from the intestine and prepare in chromate of ammonia and stain with logwood.

Fresh preparations are made by teasing the muscle in glycerine or Farrant's solution, after staining in logwood or eosin; cover and seal with Brown's cement or Hollis' glue.

To show the intra-cellular network with gold chloride:

(*a*) *Dytiscus Maginalis.* Decapitate a dytiscus; open the thorax, remove a portion of a leg muscle and place in 1 per cent. acetic acid for 5 to 15 seconds, then in gold chloride solution 1 per cent. for 45 minutes, and leave in formic acid, 25 per cent., for 48 hrs. in the dark; tease and mount in glycerine.

(*b*) BEE.—Obtain a muscle from the thorax or leg of the humble bee, prepare with acetic acid and gold chloride by the method described; a network identical with that described in dytiscus is shown. In order to obtain a muscle in as uncontracted a condition as possible, gold preparations made from the leg muscles of a bee, rendered insensible and immovable by chloroform vapor, are the best.

(*c*) FROG.—Fibers from the gastrocnemius, treated by the Au. Cl., method, yield an unmistakable network.

(*d*) Lobster muscle treated with acetic acid and gold shows the network in a most beautiful manner.

(*e*) RAT.—Employ the same method as (*d*).

Acetic acid preparations:

Muscle fibers from the leg of a *bee;* place in a dilute acetic acid solution 1 per cent. for from 5 to 15 seconds; then mount in glycerine.

On examination they seem to present a transverse row of dots

at each membrane of Krause, and longitudinal connecting rods. The network, like the sarcolemma, seems to resist the action of the acetic acid more than the matrix or sarcous substance. If the fiber be stained in hæmatoxylin after the action of the acetic acid, the network becomes stained to a greater extent than the matrix.

Osmic acid preparations are made by placing living muscles from the bee in the acid solution (1 per cent.), for 10 minutes; mount in Farrant's medium or balsam, and I would recommend the balsam made by the Palmer Slide Co.

Living fiber: The chitinous integument of the leg of the bee or dytiscus; slit longitudinally, scoop the muscle out, and quickly tease on a cover-glass and invert over the moist gas chamber.

Alcohol preparations:

I find that spirit has a tendency to split the fiber into fibrils and sarcous elements. After the muscle has been in alcohol it may be stained with some reagents. Kleinberg's hæmatoxylin, for instance, gives excellent results. Alum carmine may also be used. Mount in Canada balsam.

There is an excellent article in "Studies from the Biological Laboratory of Owen's College, England," by Dr. B. Melland.

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PROCEEDINGS OF SOCIETIES.

ILLINOIS STATE MICROSCOPICAL SOCIETY.

A MEETING of this society was held at the residence of Prof. M. D. Ewell, South Evanston, Ill., on Friday evening, October 11th. Prof. Ewell exhibited one large Rogers automatic dividing engine. This engine is the one a full description of which was published by THE MICROSCOPE; one small dividing engine, with screw three inches long; one large Rogers comparator, 114 centimeters long; one small Rogers comparator, four inches long; a variety of standards from full yard and meter down to one centimeter; a set of Kew standard thermometers; two standards by Bauchier, Paris; a set of Geissler thermometers, and two exceptionally fine standards by N. J. Green, of New York. These last are practically perfect. Also, boiling point coëfficient of expansion apparatus, etc. The

large comparator is mounted in a uniform temperature room with an air space on every side, and with triple windows on the north, protected, when not in use, by blinds.

WILLIAM HOSKINS, *Secretary.*

WESTERN SOCIETY OF NATURALISTS.

AT the recent meeting of this Society, held at Champaign, Ill., October —, the following officers were elected for the ensuing year:

President—T. C. Chamberlain.

Vice-Presidents—T. J. Burrill, D. S. Jordan, S. Calvin.

Secretary—J. S. Kingsley.

Treasurer—J. M. Coulter.

There was an attendance of twenty-eight, representing Ohio, Indiana, Illinois, Iowa, Michigan and Wisconsin. The papers were largely on methods of instruction.

J. S. KINGSLEY, *Secretary.*

ELEMENTARY DEPARTMENT.

RUDIMENTS OF PRACTICAL EMBRYOLOGY.*

W. P. MANTON.

CELLOIDINE METHOD.

§ 14. After hardening and staining, if desired, embryos may be placed for several days in a thin solution of celloidine, and then transferred to a thicker solution, where they may be left for a week or even longer, without injury. A cork is then wrapped with stiff paper—the latter projecting an inch or more beyond the former—and the top of the cork moistened with celloidine. When this has partially hardened, it is slightly moistened with ether, the specimen is placed upon it in the desired position, and the cell then filled up with the celloidine. After exposing this to the air until a film has formed on top, it is carefully lowered into a jar of 75 per cent. alcohol and allowed to harden. After a few days the paper may be removed, and the embryo will be found firmly embedded in the transparent celloidine.

Sections of the above may be mounted on a collodionized slide,

*Copyrighted 1888.

as given in § 13. When the slide is full, pour over the sections 95 per cent. alcohol, and then dissolve out the celloidine with a few drops of ether and absolute alcohol. Let these nearly evaporate, wash again in 80 per cent. alcohol, clear and mount as in § 13. If the sections have not been stained, after treating with 80 per cent. alcohol, wash in water, stain, dehydrate in alcohol, clear and mount, according to the above method.

In order that sections may be arranged with exactness on the glass slips, it is well to have a black outline of a slide, with cover-glass, on a piece of cardboard, or the very convenient centering card, mentioned by Prof. Gage in Vol. VI, p. 266, of this journal, may be used. In order to study the embryos prepared as above directed, it is necessary that the sections should be made in various directions through the specimen. Thus, in order to intelligently comprehend what we see in a transverse section (transection) in one embryo, we must have sections taken lengthwise, from behind forward, (dorso-ventral longisections) from another embryo of the same age as the first, and sections in the long axis of the body, from right to left (dextro-sinistral longisections), from still another specimen.

SECTION V.

EMBRYOS AS TRANSPARENT OBJECTS.

§ 15. From the salt solution, the specimen must be pinned out in a little of the osmic acid solution, in which it is kept until it becomes of a light brown color. It is then transferred to water, and washed for some time, to remove the osmic acid. The embryo must then be placed in 70 per cent. alcohol, then in absolute alcohol, which latter must be changed once, and finally in clove oil to clear up. This accomplished, the embryo is ready for mounting.

Having cleaned a slide, place a drop of Canada balsam on its center, and lay the embryo on this. All clove oil is now run off and wiped away, and another drop of Canada balsam allowed to fall upon the specimen. The corners of the cover-glass are now tipped with wax, to slightly raise it from the specimen, and the cover then adjusted.

On either side a hair of spun glass must be run beneath the cover glass, to keep this permanently up off the specimen. This glass-hair is quickly made by heating a bit of glass rod or tubing in the lamp-flame and then drawing it out as fine as possible, while hot.

When the balsam is dry, the wax on the cover-glass may be removed. Embryos may be treated in this manner up to the forty-eighth hour, but after that they are rather too large to make good specimens.

A COURSE IN ANIMAL HISTOLOGY.

FRANK W. BROWN, M. D.

FIFTH PAPER.

ADIPOSE TISSUE.—(1.) Take a small piece of subcutaneous fat and tease out carefully in the salt solution. Cover and examine with a low power. The fat vesicles will be seen arranged in little groups or lobules. The lobules are separated from each other by bands of connective tissue carrying blood vessels. Examining with a higher power, the connective tissue and vessels can be traced into the lobules and between the vesicles.

The vesicles are connective tissue corpuscles (plasma cells) infiltrated with fat. Before deposition of the fat, they are flat, irregular-shaped cells containing a nucleus and destitute of a membrane. The fat is deposited first in a granular form. These granules run together and form globules, which coalesce and increase in size until the cell is completely filled. During this process, a membrane is formed around the cell. The fat collects within until the membrane is made tense, and the protoplasm and nucleus of the cell are crowded to one side. Careful examination of the edges of the vesicles will show the nucleus and protoplasm, which appear as a thickening of the fibrous septa.

(2.) Squeeze the specimen between cover and slide. On examination a few ruptured vesicles will be seen, showing the cell membrane.

(3.) Boil a small piece of adipose tissue in stronger alcohol for five minutes, and then boil in ether for the same length of time.* Mount in salt solution and examine. The fat having been removed by the ether, exposes a good view of the cell membranes and fibrous septa.

(4.) Stain a piece of fat tissue in carmine, wash, dehydrate and mount in balsam and examine. The balsam renders the fat transparent, and the cell-body, with contained nucleus, deeply stained, can be studied. A number of lymphoid (wandering) cells will also be seen. The specimen can be preserved, if desired.

(5.) Place a piece of omentum containing small groups of fat lobules, in a one per cent. solution of osmic acid until it assumes a brownish-black color. Mount in balsam and examine. The fat has taken up the color, allowing a study of the contour of the vesicles and their arrangement in lobules.

* Care should be taken when boiling in ether that the vapor be blown away as it arises from the test tube, as it is inflammable and may ignite.

FAT-CRYSTALS.—In examining adipose tissue long removed from the body, or, occasionally, directly after removal, a few vesicles will be found, containing crystals of the fatty acids. They resemble delicate burrs, and are composed of fine, needle-shaped crystals. If they are not to be found in the specimens at hand, it is only necessary to mount a small piece of tissue in glycerin and set it away for a time, when they will gradually form.

YELLOW ELASTIC TISSUE.—Take a longitudinal snip from the ligamentum nuchæ of the ox. Allow it to soak in a moderately strong solution of sodium chloride in water (about 15 per cent.) for a few days, tease out in glycerin and examine. The fibers are thick, branched, and communicate with each other. The free ends will be found curled up, showing their elasticity. No nuclei are discernible. With a moderately high power, the fibers will be found to have delicate transverse markings at intervals. The cause of these is unknown. Elastic tissue is seldom found in a pure state, being mixed with more or less white fibrous tissues. The white elastic tissue mentioned in the last lesson, is quite identical with the yellow variety, although of much finer texture and color. Elastic tissue occurs in a comparatively pure form in the ligamentum nuchæ and ligamenta subflava of the vertebræ, in the walls of the bronchi and connecting the laryngeal cartilages. It is mixed with white fibrous tissue in the serous membranes, subcutaneous tissue, intermuscular septa, etc. Elastic tissue does not always occur as bundles of fibers. In the blood-vessels it takes the shape of a membrane, as it does in Bowman's and Descemet's membranes of the cornea and the basement membranes underlying many epithelial surfaces.

EDITORIAL.

MANY professional men who use the microscope as an auxiliary to their work never succeed in making a collection of objects for future reference and study, partly because they are too busy, and partly because they do not consider the object to be mounted as worthy of preservation. The meagre collections of such individuals will consist of examples of rare specimens in their work, hardly as valuable for study as a larger number of the every-day objects. It is the unexpected which often happens. How often it occurs to constant workers with the microscope that a specimen, hardly deemed worthy of permanent preservation, is extemporaneously mounted in

glycerin merely to make sure of a diagnosis, is found to contain some rare or beautiful features. But there it is in glycerin, carelessly mounted and quite prepared to be thrown away, and, unless it happens to be a very rare object, it *is* thrown away.

Dr. R. H. Ward, of Troy, N. Y., has an article on this point in the last number of *The Journal of Microscopy and Natural Science*, and recommends Farrant's medium as a quick and convenient first and final mounting material. In corroboration of what we have said, he writes: "Objects almost without number are examined for purely scientific investigation, or for sanitary, economic, medical or legal purposes, and then are inevitably thrown away for want of the time required, but not just then available, for mounting them. Such objects are often examined in glycerin, and proving interesting, they are laid aside unsealed, only to be found spoiled when next seen, or are ringed with varnish, without a cell, to make a mount that will be short-lived by reason of the running in or splitting off of the cement. It is no more trouble to place such objects, and cover them, in the gum and glycerin medium at first, than in plain glycerin; and then they are already mounted to begin with, and they can, as desired, be washed off the next day, or be neglected for years without injury." As the Farrant's medium the doctor recommends is somewhat different than the one used by us, and because he speaks of it as permanent, we give it here:

Picked gum arabic.....4 parts by weight.
Distilled water (cold)....4 " "
Glycerin .....2 " "

Keep in a glass-stoppered bottle, in which should be put a small piece of camphor. The directions given by the doctor do not differ materially from those found in the books on the use of the medium.

We advise some of our busy readers to try it and watch the growth of a collection which has cost them no extra work more than has been given to the specimens heretofore thrown away.

ACKNOWLEDGEMENTS.—From C. Wellington, Jackson, Mich., mounts of vegetable tissues; from J. Krutschnitt, New Orleans, La., mount of epidendrum ovary; from L. A. Harding, mount of chromate of strychina; from W. Orin Tasker, Haverhill, Mass., photomicrograph of one of Rimböck's slides of arranged diatoms, 273 objects.

PROFESSOR W. K. BROOKS contributes to the September and October *Popular Science* monthly some papers on sponges that will be of interest to microscopists.

TECHNOLOGY.

LIQUIDS FOR RE-MOISTENING BLOOD.—In his admirable article, "Comparative Studies of Mammalian Blood," published in the *Jr. of Comparative Medicine and Surgery*, Dr. Henry F. Formad gives the following list of liquids useful in the re-moistening of blood which has become dried, for microscopical examination :

1. Virchow or Moleschott's liquid :

   Caustic potash.....30 to 33 parts.
   Water.....70 parts.

2. Müller's fluid.

   Bi-chromate of potassium..... 2 parts.
   Sulphate of sodium..... 1 "
   Water.....100 "

3. Wilbert's fluid.

   Bi-chloride of mercury..... 0.5 parts.
   Chloride of sodium..... 2.0 "
   Water.....100 "

4. Pacini's liquid:

   Water.....300 parts.
   Glycerine.....100 "
   Chloride of sodium..... 2 "
   Bi-chloride of mercury..... 1 "

5. Ranvier's liquid. (Iodized serum.)

   Potassium iodide..... 2 parts.
   Iodine sufficient for saturation.
   Water.....100 "

6. Malassez' artificial serum.

   Solution of gum Arabic, sp. gr..... 1020
   Solution of chloride of sodium, sp. gr.... 1020
   Solution of sulphate of sodium, sp. gr.... 1020
   Of each equal parts.

7. Roassin's liquid.

   Glycerine..... 3 parts.
   Sulphuric acid..... 1 "
   Water sufficient to make the liquid of
   specific gravity of.....1028.

8. Robin's solution is a saturated solution of sulphate of sodium.

9. Richardson's salt solution.

Chloride of sodium	0.75	parts.
Water	100.	"

Having the corpuscles isolated by this liquid, he stains them with a little anilin.

10. Welcker's fluid.

Glycerine	1	part.
Water	7	"

11. He also uses the following solution (artificial serum).

Chloride of sodium	4	parts.
Egg albumen	300	"
Water	2700	"

12. Malinin's solution. Saturated alcoholic solution of caustic potash. (90 per ct. alcohol.)

Dr. Formad proceeds to examine a specimen in this way: A small granule of the suspected blood, or a fiber from the blood-stained fabric is placed on a glass slide in a drop of a 30 to 35 per cent. solution of caustic potash, and covered with a cover-glass. If the blood stain was recent, the disintegration of the clot commences at once, and the isolated corpuscles separate and swim swiftly through the liquid, if the stage of the microscope is slightly inclined. * * * In direct proportion to the age of the stain, from one to within ten days, the softening of the microscopic blood mass and the isolation of the corpuscles is protracted. In blood older than ten days, the ratio of softening or disintegration cannot be well observed, and a stain of two years old behaved like one of ten days.

SERIAL SECTIONS WITH CELLOIDIN.*—The celloidin block, with the object imbedded, is cut as regularly as possible, and fastened to a cork. In sectioning, the knife should be placed nearly parallel with its direction of motion, and after every five to ten sections wet with 95 per cent. alcohol. The sections are raised from the knife with a small brush, and placed on the surface of bergamot oil (in a small glass dish over a white ground). If the oil is good the sections will at once unroll and become transparent.

* J. Apáthy. Methode zur Verfertigung längerer Schnittserien mit Celloidin. Mitth. a. d. zool. Station z. Neapel., vii , 4, p. 742, 1887.—*Am. Naturalist.*

Bergamot oil is in every respect the best to use in celloidin technique. Origanum oil may be used, but its action is violent and often causes the colors to fade. Good bergamot oil is clear grass-green, with at most a slight yellow tinge (yellow oil is always bad), does not smell of terpentine, and mixes with 90 per cent. alcohol without turbidity or formation of water drops on the surface. The little cloudiness produced by breathing on the latter, should at once disappear. Aniline colors ought not to fade perceptibly in bergamot oil even after forty-eight hours ; while celloidin ought not to be softened by it in the least ; on the contrary, sections that have been softened by strong alcohol should acquire greater firmness in bergamot oil.

Tracing paper must first be cut into strips about as broad as the object-carrier, and at least three times as long as the cover-glass. The shape of the latter is marked on one end of the strips. The paper must be perfectly smooth, well oiled and transparent, and unite some stiffness with flexibility. The strip should be held by its free third, horizontally, in the oil, supported from beneath by the middle and third fingers, and held from above by the thumb and first finger, so that a slight longitudinal and upwardly directed concavity can be given to it. Thus the immersed end of the paper, on which the sections are to be arranged, can easily bear a slight weight without bending. Now, while the left hand holds the strip of paper over the surface of the oil, the right draws the sledge of the microtome with the little finger, and also turns the micrometer screw. Between the middle and third fingers of the same hand, a fine elastic brush is held, supported by the ball of the thumb, and between the first and middle fingers and the thumb a very sharp but strong dissecting needle. The section is removed from the knife, where it lies in plenty of 95 per cent. alcohol, with the brush, and put on the oil; here it is followed with the strip of paper held beneath and guided near the position where it should lie ; then drawn with the needle out of the oil on to the paper. Ths sections are arranged in cross rows, which are held from 2 to 3 mm. out of the oil to prevent them from swimming away. The rest of the paper remains in the oil and is only withdrawn as it is covered with sections. When the desired number of sections has been brought into order on the paper, the oil is drained off, and the paper is then turned so that the sections face downwards. In this position the strip is allowed to fall slowly on the object-glass. Then it is flattened out with a dissecting needle and dried with blotting-paper. Now the tracing-paper,

through which the whole series can plainly be seen, must be carefully removed, leaving the sections on the object-glass. If any sections should remain on the paper, the latter, after the sections in question have been moistened with oil, is replaced in its former position on the object-glass, pressed a little, and then removed, or if the sections are quite dry they may be taken with pincers and transferred to the object-glass.

As soon as all the sections are in order on the object-glass, the smooth surface of the blotting-paper is laid on it and stroked lightly several times with the finger to remove all the superfluous oil.

The Canada balsam and cover-glass may now be added without danger of displacing the sections. Entire removal of the oil insures the preservation of the most fugitive colors. The sections should not be placed near the edge of the cover-glass, as every discoloration begins at the edge.

In the foregoing manner, over 100 sections were placed in a complete series under one cover-glass, in as short a time as by the paraffin methed.

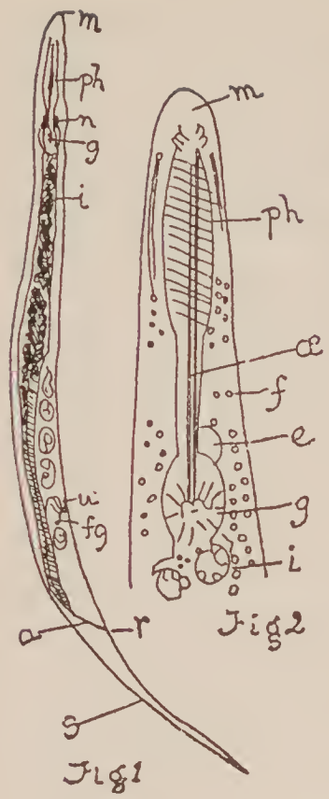
As celloidin, like paraffin, does not readily penetrate chitinous envelopes, cuticula and cocoons, care should be taken :—

1. To use at first very thin solutions, which should be gradually brought to the concentration which the imbedding mass is to have.

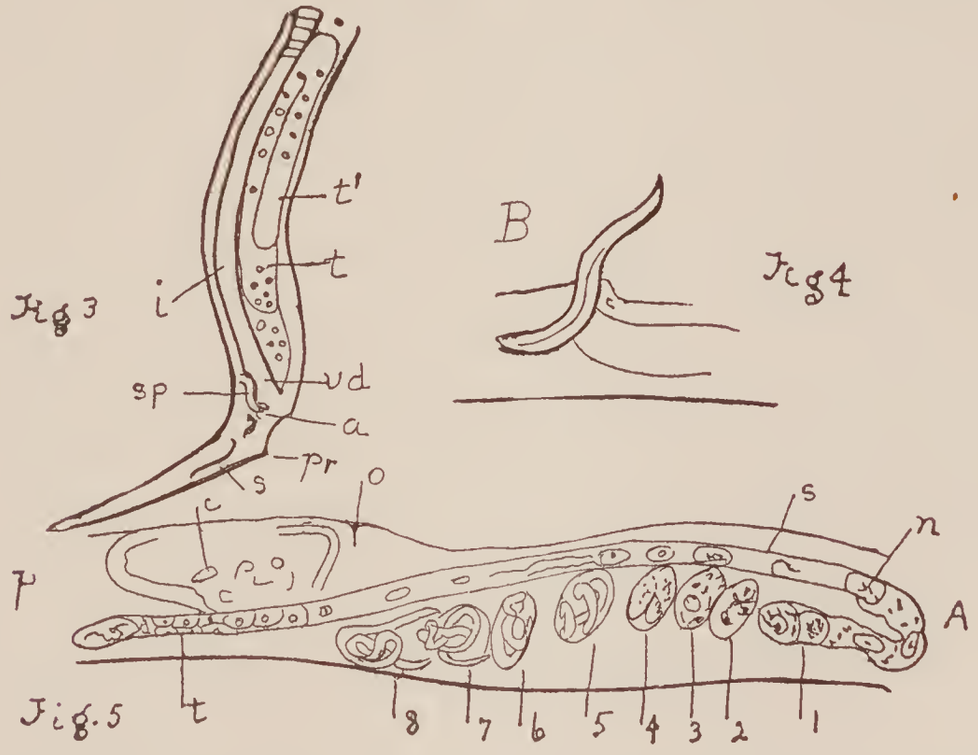
2. To imbed twice, the first time merely to cut the object in pieces, or open a cocoon, or cut, etc., with the microtome.

ABSTRACTS.

THE VINEGAR EEL.—The mature female is about one-tenth of an inch in length, the mature male one-fifteenth, but both sexes vary in size. The body is long and filiform, of nearly uniform thickness, tapers gently toward the head, but less gradually toward the tail, which ends in a long, fine spine. (Fig. 1). The females are viviparous, and the young may be seen in a mature female inside the body. The two sexes are much alike in external appearance, the only difference being that the tail of the male has three



small processes (Fig. 3, pr). The alimentary canal is a straight tube, traversing the whole length of the body cavity. The small mouth, which opens anteriorly, is surrounded by a horny capsule (Figs. 1 and 2, m). The pharynx (ph.) has muscular walls, with transverse striæ, and leads into a narrow œsophagus (œ). The gizzard (g) is round and very thick-walled, muscular striæ radiating from the small central cavity. The remainder of the digestive tube consists of a long, hind-gut or intestine (Fig. 3, i) which occupies the greater portion of the body. The anterior portion of this organ is broad and much serrulated; near the reproductive system it becomes narrow, and passes to one side. A short rectum leads to the anus, which opens near the root of the tail. The reproductive organ of the male is a long, broad testis, which is bent upon itself at its upper portion, and opens by a very short vas deferens at the anus (Fig. 3, sp.). Two conspicuous spicula, shaped like the letter S, and contained in sacs, are situated at each side of the vas deferens and open into it; they act as claspers during the sexual process. In



the female the generative opening is situated a little behind the middle of the body. This opening leads into an oval chamber, and the broad pouch. The large uterus, or broad pouch, seems more like a cavity hollowed out in the body, than a chamber having definite

walls (Fig. 5). This pouch passes forwards and ends in a long protoplasmic cord or ovary (?) which bends and passes over the intestine. The broad pouch often contains embryos in various stages of development, the youngest being at the extreme end, and the older ones nearer the generative opening. Some of the youngest may be seen invested in a delicate shell, undergoing segmentation.

When the eel has finished its early stages of development inside the mother, it escapes by a wriggling motion from the generative passage (Fig. 4), and shortly after becomes very lively.—*Science Gossip.*

COLORS OF FRESH WATER ALGÆ.—The colors of our fresh water algæ, says Edward S. Burges, in the *American Naturalist*, are varied to a degree that may surprise the student who expects only green. There is considerable variety, even in their green, from the grass-green of the spirogyras to the pea-green of some palmellas, the little "water-flower," so to render its name, *Anabæna flos-aquæ*, is a verdigris-green; *Chlamydomonas hyalina* is called by Wolle a milky-green. Many shades of red are found, vermilion in Chlamydococcus, scarlet in Thorea, blood-red in *Glœocapsa sanguinea*, amethystine in *Leptothrix tinctoria.* Hildebrantia is often purple, one of the Chantransias is rose-purple, Lemanea is violet; species of Chroölepus range through ash, yellow and orange to golden red; Tuomeya is said to be olive-colored; Hydrurus ochre; some Vaucherias are brown, one Glæocapsa is black, a Leptothrix is straw-colored, another fawn, a Chantransia steel-blue, a Cylindrocapsa pearly. Many preserve their colors when dried, others change, some simply by fading to a lighter shade of their previous color, others to a new tint. One Batrachosperus is described as at first of a mouse-gray color, then yellow, and on drying, violet; *Chantransia macrospora* and Thorea are, when living, dark green, but dry a beautiful purple-violet; the Sweet Chroölepus is tawny when fresh, changes to an ashen-gray and finally greenish; a kindred species is reddish-orange, then olive, and light yellow on drying; *Zygnema purpureum* changes from purplish green to dark purple. *Lyngbya tinctoria*, says Wolle, from purple to violet steel; *Vaucheria dichotoma* may stand as a type of the change so frequent in the higher plants, from green to brown. Many algæ unite several colors at the same time, almost all do so when we compare the spores with the vegetative growth. A remarkable instance of variegation in vegetable growth alone is seen in a new Lyngbya found by Wolle in the Lehigh at Bethlehem, Penn., waving in tufts six inches long, "the extremities bright blue-green, lower

parts changing to yellow-brown; and at last fading out to a colorless base."

THE GERM THEORY OF THE DENTAL CARIES.—W. D. Miller, *Independent Practitioner*, has discovered that the bacteria found in the mouth and in dental cavities is an acid-producing anærobic fungus, thus accounting for the peculiar manner in which teeth are destroyed. Whenever, either between the teeth, in sulci or pockets, through faulty development, a lodgment can be had for food products, a miniature acid manufactory is set up. The acid freed in this manner decomposes at once that portion of the tooth, with which it comes in contact, uniting with its lime salts, and forming new combinations and, as decalcification advances, bacteria follow after, throwing out in their growth new waste products in the form of lactic acid. The sugar, which is ever present in the mouth in some form or other, is the natural ferment food on which these bacteria thrive, and if by any chance it is not present, the ptyaline of the saliva soon produces it by its action on the starchy elements in our daily food. Experiments with pure cultures of this bacteria upon sound teeth showed that the tooth became softened and pliable at the end of the first week, and that by the close of the second week, it was completely decalcified and could be easily cut with a knife. Stained sections of the tooth showed all the well-known signs of dental caries to be present.

Three separate ferments are produced by the fungi of dental caries. The first, an inverting ferment, one capable of changing a non-fermentable sugar, like cane sugar, into a fermentable one, and possibly of forming a sugar from starch. The second, an acid producing ferment, the product of which has been proved to be lactic acid. The third a peptonizing or digestive ferment. All play important parts in the work of tooth destruction. The first prepares the food for the second. The second dissolves out the lime salts of the tooth, and leaves it an easy prey for the third, which, in turn, eats up, dissolves, the animal basis left after the mineral matter has been removed, and reduces the whole to a pulpy or fluid condition.

DERMAL SENSORY ORGANS OF INSECTS. — Dr. O. vom Rath, (*Zeitsch. f. wiss. Zool. xlvi., 1888. Jr. R. M. Soc.*)

In regard to the physiology of these organs, little is definitely known, and as the structure of the various organs is essentially the same, nothing can be concluded therefrom. The most important position is that of the antennæ. Here we find sensory hairs, cones,

and membranous canals. The author thinks that the olfactory sense is located in the sensory cones, and perhaps also in the membranous canals, and that the hairs have a tactil function. The function of the canals appears to be one which is well developed in a few insects only, as they are only occasionally present; where they are found, they are present in large numbers. It is not likely that they are of an auditory nature, but it is more probable that they serve for the perception of definite odors, or fulfill some unknown function. It is only in rare cases that it can be definitely asserted that there is an orifice at the anterior end of the cones, and this point seems therefore to be of little physiological significance. The chitin at the anterior end of the cone is in any case thin and pale, and is probably affected by chemical and physical influences. Treatment with diluted potash easily dissolves the chitinous membrane, when the cone is laid open. Where the cones stand in chitinous pits, and do not reach the surface, we cannot suppose that there is any tactile function, but rather an olfactory. If this be so, and there are different kinds of cones, we may suppose that these have somewhat different functions. It is possible that some serve for the perception of the feeble odors of distant objects, and others for those that are nearer.

On the palpi cones and hairs are alone found. Leydig was certainly justified in declaring that their anatomical structure shows that the palpi have the same or similar functions to the antennæ. Vom Rath believes that the cones are olfactory organs, and probably perceive not-distant odors. The cones on the maxilla, labium, epipharynx and hypopharynx seem to be gustatory organs.

THE UNIT OF MICROSCOPICAL MEASUREMENTS.—Considerable confusion has grown up of late, not only in this country, but in England and Continental Europe by the use of the word "micromillimetre" as synonymous with "mikron," and thus designating the micrometrical unit, viz: one one-thousanth part of a millimetre. A paper on the subject from the pen of Prof. A. W. Ruecker, and published in *Nature* (No. XXXVII, 1888, p. 388) calls attention to the fact that by the action of the Royal Society on the report of its Committee on the selection of Dynamical and Electrical Units, the term *mega* is used to denote multiplication, and *micro* for division, by one million; and hence as a *mega* millimetre would mean a million millimetres, so a *micro*-millimetre should, and does, signify one millionth of a millimetre. *Micron* or *mikron*, however, means the one-

thousandth part of a millimetre and has already been adopted as a standard of microscopical measurements under this signification by numerous learned associations, among others we may remark, by the American Society of Microscopists. From the Journal of the Royal Microscopical Society for June (No. 64, p. 502) we are glad to note that this article of Prof. Ruecker has been brought before the Council of the Society and that the latter adopted a resolution to the effect that the word *micron* (symbol μ) should henceforth be used in the *Journal* and in the official proceedings of the Society in the place of *micro-millimetre* and to signify the microscopical unit of one one-thousandths of a millimetre.—*St. Louis Med. and Surg. Journal.*

VACUOLES.—F. Went has, in the last part of Pringshem's *Jahrbücher für wissenschaftliche Botanik* (vol. xix, pp. 295–356) an exceedingly important paper on vacuoles. His conclusions, in his own words, are as follows: "With the exception of the doubtful spermatozoids, Cyanophyceæ and Bacteria, all living cells contain vacuoles, which are surrounded by a special living wall, which bears the name of 'tonoplast.' In all young cells division and coalescence of vacuoles takes place. All normal vacuoles of a plant arise through continual division from those of the oosphere. The tonoplasts, considered as organs of the protoplasm, are of equivalent origin with the nuclei and chronatophores. Since the vacuoles, even in the youngest cells, are continually changing their shape, protoplasmic movements must take place in them, and does not begin, as Hofmeister thought, only after the meristematic state is past. Normal vacuoles never arise from the protoplasm. Pathological vacuoles are formed by the disorganization of the nuclei and chromatophores. The paper concludes with a summary of the present knowledge in regard to the vacuoles."—*Botanic Gazette.*

VARIETY IN FORM OF UNICELLULAR ALGÆ.—There is great variety of form among the algæ of fresh water, even among the unicellular species. It might be thought that these species, where the whole plant is composed of but a single cel , would present little variety, especially when it is considered that such simple cells commonly float loosely in the water, and in situations enabling the supposed normal spheroidal, cell-form to develop itself, free from the influences of crowding or lateral stimuli. But not so simple is the plan of nature, and a great range of shape exists among the sin-

gle-celled algæ, from the spherical of the common protococcus of our trees and walls, to the burr-like, spiny Polyedrium. For instance, one Raphidium is crescent-shaped, another needle-shaped, another unicellular algæ is shaped somewhat like the letter S, another like a J, another a C. The Botrydium is balloon-shaped, the Chytridium often urn-shaped, others appear as little discs, others ellipses, others cubical or pentagonal. When associated in masses, pressure and the exigencies of growth change the shape of those naturally circular into irregular polygons. Some species of Ophiocytium grow into curious coils; some Polyedriums are exact triangles, others take the form of a Greek cross. Extend our view to the desmids and diatoms, which are also of the unicellular algæ of fresh water, and the number of cut and fantastic forms which a plant of a single cell may present, becomes indefinitely increased.—*E. S. Burgess in Am. Naturalist.*

NEWS AND NOTES.

PLYMOUTH, England, has a new marine biological laboratory.

AT the recent assembly of the Agassiz Association at Ashbury Park, Prof. F. C. VanDyck, of Rutger's College, held a *conversazione* on how to use the microscope.

PROF. FAIRCHILD, of New York, has been elected to the chair of natural history, University of Rochester.

ONE of the most interesting features of bacterial life is found in their waste products and the influence they exert on the media in which they grow. It is not common to think of waste products in connection with plant life, but they are no more a feature of animal life than they are of plant life.—*Allan.*

MR. EDWARD S. BURGESS recommends preserving specimens of algæ for microscopical examination in cement cells, using as a medium King's fresh water-algæ fluid.

PROF. W. G. THOMPSON took as the subject of his discourse at the term opening of the Loomis Laboratory, N. Y., "The Laboratory as a factor in Medical Education."

REV. WALTER HOWCHIN, F. G. S., in a paper recently read before the Royal Microscopical Society, London, adds to our knowledge four new genera and thirteen new species and varieties of carboniferous fossils.

ACCORDING to the *Prager Rundschau*, flash powder for taking

instantaneous photographs is composed of coarse sugar and powdered magnesium, of each one part, and chlorate of potassium two parts. If the sugar is too fine the explosion will be violent.

BOOK REVIEWS.

PRIMARY METHODS IN ZOOLOGY TEACHING, FOR TEACHERS IN COMMON SCHOOLS. Illustrated. By W. P. Manton, M. D. Boston: Lee & Shepard, 1888.

This latest addition to Dr. Manton's Practical Helps in Natural History series, was originally contributed to an eastern journal of education, and meeting with so kindly a reception by the readers of that periodical, it was decided to republish in manual form.

The text is a curious blending of comparative anatomy and physiology, with enough microscopy to enable the teacher to instruct even the youngest pupil. But the chief merit of the little book lies in the suggestions it gives in regard to making the study of zoology interesting,—something more than the mere learning of names.

Teachers and others, who have had little experience in zootomy, will find much in this manual of value and assistance to them in the practical parts of their work. It is well worth a careful reading, and we feel sure that if the instructions are followed as given, the results will be eminently satisfactory.

DARWINISM, A brief account of the Darwinian theory of the origin of species. By David Starr Jordan, Ph. D., M. D. Chicago: A. B. Gehman & Co., 1888.

Dr. Jordan presents in this essay a brief and popular statement of the main features of a theory which is known, by name at least, to every one. The matter is treated in the writer's well-known, clear and concise manner, and affords pleasant reading, while at the same time it epitomizes the features of the theory of organic evolution.

PROCEEDINGS OF THE AMERICAN SOCIETY OF MICROSCOPISTS. 1888. Pp. 359.

With each year the record of the proceedings of this Society grows in interest, and this volume, for 1888, proves to be no exception. The papers, of which a number have appeared in THE MICROSCOPE, are mostly of high character, and show, in many instances, evidences of much hard work and original research. We fear, however, that the long delay in getting out the volume will detract somewhat from the interest in its contents. The Committee on Publication cannot be blamed for this delay, as a number of

unforeseen hindrances greatly neutralized their work. The index, which should have appeared in this volume, will be added to the report for this year, now well along toward publication.

THE NATURALISTS' POCKET CALENDAR. By Stanley Brigg and Arthur Hollis. London: W. E. Bowers, 1888.

This neat little calendar will be found useful to those who are accustomed to note the times and seasons. It gives the times of migration, nidification, etc., of birds, and the habits of animals, fishes, reptiles and insects for each month in the year. Finally, there is an interesting and curious table of weather warnings, a page or two on "Plants as Weather Guides," and a statement regarding barometric readings. It is well worth the three pence asked for it.

TRANSACTIONS OF THE MICHIGAN STATE MEDICAL SOCIETY. 1888. Pp. 364.

These Transactions will compare favorably with those of other State societies, which they resemble in that they contain a like proportion of very good and rather poor papers. To the Secretary is largely due the credit for the clean proof and acceptable appearance of the volume.

PROCEEDINGS MICHIGAN STATE BOARD OF HEALTH, 1888.

Proceedings of the Sanitary Convention held at Manistee, June 5 and 6, 1888.

THE CAUSATION OF COLD WEATHER DISEASES. By Henry B. Baker, M. D. Reprint.

RECENT ADVANCES IN STATE MEDICINE. By Henry B. Baker, M. D. Reprint.

ANNUAL REPORT OF THE MURDOCK FREE SURGICAL HOSPITAL FOR WOMEN. 1888.

COLLINS' CATALOGUE, October, 1888.

Collectors of rare works and others should send to Mr. Collins for his monthly issue of this list.

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SOME OF THE ADVANTAGES OF THE UNION OF MEDICAL SCHOOL AND UNIVERSITY. By William H. Welch, M. D. Reprint.

DARWINIANA, A Catalogue of scientific and philosophical works, selected and arranged to illustrate the evolution of research, etc. W. P. Collins, London.

CATALOGUE OF ZOOLOGICAL AND PALÆONTOLOGICAL BOOKS. Part III. Mollusca and Mulluscoida. Dulau & Co. London.

CORRESPONDENCE AND QUERIES.

To the Editors of the Microscope:

GENTLEMEN—I was pleased to note your timely editorial on the use of light in the July issue of THE MICROSCOPE. The majority of us find it is entirely out of the question to try and make use of natural light (diffused sunlight). We cannot devote the daytime to such work, and, in a smoky city like St. Louis, could not use daylight to an advantage, even if we had the time. I keep two lamps on my work-table. One is a large student lamp that aids me when mounting or preparing specimens. The other is a cheap brass hand-lamp, that serves as a source of light for the examination of objects. When using the latter I turn the flame of the former down, so that its rays will not interfere with the small lamp. Another advantage this summer weather, and not a very small one either, is that the small lamp does not heat up the room. When examining objects I never have more than one light in the room, and above all avoid the flickering flame of a gas jet.

I fully appreciate the work that our manufacturers are doing in the interest of microscopy, but I do not believe that they should put so much stress upon the value of expensive lamps. Nor could I ever understand why they should charge from five to six dollars for lamps that can be bought in a lamp store for three to four dollars.

In a new book just received, I notice that the author advises the operator to illuminate the objects surrounding the microscope as brightly as the field is lighted. I believe this is not only a useless precaution, but is also one that will interfere with the proper examination of many objects.

When it is desirable to use oblique light, the diffused light from such an illumination would cause much trouble. I also find that when working with the polariscope that but one light should be used, and, as far as possible, all the rays concentrated on the mirror.

H. M. WHELPLEY.

St. Louis, Mo.

How can I keep the knife of my section cutter bright when not in use? Despite all my precautions, minute spots of rust appear.

B.

Is there a better green for use in double staining wood sections than malachite green?

C.

EXCHANGES.

This department is for the benefit of SUBSCRIBERS *who have microscopical apparatus, material or books which they wish to exchange, and such wants will be* INSERTED FREE OF CHARGE. *The number of insertions given will depend upon the number of exchanges received each month. Subscribers will please notify us when articles have been exchanged or sold. Dealers are referred to our advertising department.*

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D B. WARD, Poughkeepsie, N. Y.

FOR EXCHANGE—A new and clean copy of Stowell's Manual of Histology—last edition. Wanted—Second-hand copy of Beale s "How to Work with the Microscope." Also, first-class slides of the orange tree insect, to exchange for diatoms in tubes.
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FOR SALE—Beck's Popular Binocular Microscope, 5 objectives, 5 eye-pieces. mechanical stage and all accessories, mounting material, slides, etc. Cost about $400. For sale at $150. For list of apparatus, etc., address
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FOR SALE CHEAP—Microscope stand with four eye-pieces, cost $60, never been used; also, Bunsen's Spectroscope, cost $75. For description and price, address
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M. S. WIARD, New Britain, Conn.

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F. W. LOWDER, Sioux City, Iowa.

WILL EXCHANGE for objectives or other microscopical appliances, a Standard Columbia Bicycle, 48 in. large wheel, in good condition. Address
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VOL. VIII. DETROIT, DECEMBER, 1888. No. 12

ORIGINAL COMMUNICATIONS.

ON THE DEVELOPMENT AND A SUPPOSED NEW METHOD OF REPRODUCTION IN THE SUN ANIMALCULE ACTINOSPHÆRIUM EICHHORNII.*

JOHN M. STEDMAN, B. S.

EARLY in March my attention was called to an aquarium which had been standing in my window during the winter, and which contained anacharas and algæ in great abundance, but which now suddenly presented a quantity of light pink substance on the sides of the jar. It was the appearance of this pink colored material among the debris of decaying and growing algæ that attracted my attention. Accordingly, a small piece of the substance was spread out on a slide and examined, when, to my surprise, it was found to be composed of sun animalcules of various sizes, among which were other bodies, the true nature of which I did not at first quite understand, but which, on close examination, proved to be the young of the larger heliazoa. So numerous, indeed, were the young heliazoa, that not a single field of the one-fifth objective and a ocular could be chosen in which there were less than half a dozen, and usually the number was very much greater.

Such an unusually great and rare opportunity to study these animals could not be neglected.

Fortunately, they were discovered in the morning, and by close and constant observation for several hours their true relations to the numerous small bodies were satisfactorily demonstrated and proven to be different stages of the same animal.

* Transactions American Society of Microscopists, 1888.

For a description of *A. Eichhornii* and of its habits, see "Fresh-water Rhizopods of North America," by J. Leidy, p. 259, plate XLI.

We will pass at once to the special subject in hand, beginning, for convenience, with the simplest or youngest heliazoan.

Development.—Let it not be understood that the order in which I am now to describe the different stages of development is the order in which I observed them. On the contrary, what I shall first describe really came about last in my observations, since I did not at first take the youngest stages of this heliazoan to have any connection with the larger heliazoa. My observations began with an undoubted heliazoan of this species (Fig. 13, of my plate), and from that I worked both ways, but principally to the younger. It would have been impracticable to have watched the development of a single heliazoan from the very youngest individual to the full grown animal, since it would have required not only a constant observation for a much longer time than I could spare, but would also have needed some little care. As it was, I could watch a young heliazoan until it had developed a few stages, and had considerably lessened the near supply of food, and then I could find another heliazoan of the same stage as the one just discarded but which was in more favorable circumstances for further growth. As indicated, the number of heliazoa was enormous, and the different stages represented by the scores. Had I suspected these various stages to have been what they were, there would have been no trouble in finding a complete set, for every gradation, from the youngest to the adult, was present in great quantities. Fortunately, there were quite a number of worms—*Dorylaimus stagnalis*—in the water, and their constant wiggling about kept the heliazoa and other animals in perpetual motion, so that they came in contact with one another where, otherwise, they would not have done.

A far greater number of observations were made than I shall here describe. Enough were chosen, however, to form a complete series, and accurate drawings made of them. I shall, therefore, describe only those observations which I have illustrated, hoping that the series will be full enough for our purpose.

I think it is safe to say that were this minute mass of protoplasm which constitutes the youngest heliazoan observed by itself for a little while, no one would mistrust its true nature or relations. Indeed, it was only after a long and continued observation, and that under the most favorable circumstances, that I became convinced of its true

nature. It is nothing but a minute spherical mass of finely granular and hyaline protoplasm, 14.5 μ in diameter, with a contained nucleus and a distinct nucleolus (Fig. 1). In appearance, it resembles white blood-corpuscles, with a distinct and sharply defined nucleus. Later, however, a vacuole appears in its substance, and, increasing in size, often becomes larger than the original mass of protoplasm, so that the latter forms but a thin layer surrounding it (Figs. 2, 16, 12). In this stage a pseudopodium or ray may be present (Fig. 12).

Two heliazoa of the first stage were seen to come together, which, however, as in nearly all cases, was due to the agitation of the water by the worms, and, immediately upon touching one another (Fig. 23), to fuse and run together, just as a drop of water fuses with another drop of water. It is impossible to say which of the two was devoured; both appeared to play an equal part, the vacuole and nucleus of both being present, and the whole immediately assuming a spherical form, and appearing (Fig. 3) much like any one of the two of which it is now composed, except that it has two vacuoles and two nuclei. In the course of five minutes this young two-vacuoled heliazoan had developed a ray, and in its interior the characteristic axis thread could be distinctly seen (Fig. 20). The absence or the number of rays when present in the young heliazoa is of no special value, and varies with different individuals of the same age, as will be seen from the figures.

Whether this fusion of two individuals of the same species be called eating or not, does not concern us, and I shall not attempt to discuss the subject here. As a matter of fact, however, it is not conjugation for purposes of reproduction, or rejuvenescence, as will be seen later; and, since we have these animals developing by this method of increase, as well as by that of an undoubted eating of other animals, it matters not, so far as development is concerned, whether they appropriate material so near like that of their own bodies that it needs no change to form a part of them, or whether the food be different, and, hence, have to be changed or digested before it can be so appropriated. I have observed farther advanced heliazoa capture infusoria and amœba and surround them, and draw them into their interior, where they remained to be digested; and at the same time I have observed those same heliazoa capture other heliazoa, and, instead of drawing them into their interior and surrounding them, as they did other bodies, they would draw them in until the two heliazoa touched, when there occurred a fusing and blending of the two animals into one, just so much larger. My only

explanation is that, as indicated, the protoplasm of the two animals is *exactly alike*, and, hence, there can be no need of digestion. Were one of the heliazoa dead when it came in contact with another which would otherwise have fused with it, I have no doubt but that the dead heliazoan would be surrounded and drawn into the interior of the live one, the same as other animals are, and there digested, it being *not exactly alike* the protoplasm of the one which is alive. For if this were not the case, if the dead heliazoan, upon contact with the living heliazoan, were to form a part of it, as the living heliazoan did, then we should have a case where simple contact of the living protoplasm with the same, but dead protoplasm, would impart life to the dead, just as a piece of iron, which is magnetized, if brought in contact with one which is not, will impart magnetism to it. But it is needless to say that such a phenomena of life has never been observed.

While watching the heliazoan (Fig. 3, 20) which we have just described as being the result of the union of two of the youngest individuals, (Fig. 2, 23), the water was stirred by a worm, and another heliazoan, of about the same size as the one under observation, but with three vacuoles and no rays, was brought nearer and nearer, until finally they accidentally came in contact with one another and immediately united (Fig. 20) and assumed a spherical form. Presently the single ray disappeared, and three more vacuoles made their appearance in the mass of protoplasm, together with the development of a contractile vesicle (Fig. 5). This individual was watched until it had developed three rays and several more vacuoles (Fig. 6), a process requiring about twenty-five minutes, during which time it had eaten nothing except one of the youngest heliazoa without a vacuole. Under the one-twelfth oil immersion I was able to detect the axis cylinder in two of the rays, but not without some doubt in the third ray.

Very near this individual (Fig. 6, 26) was another heliazoan of a much greater size (Fig. 25), and by touching the cover-glass with a needle, I soon brought the two so near that the tip of one of the rays of the smaller heliazoan touched the larger animal. Wishing to observe the result of this contact, I waited a few minutes, when it became apparent that the smaller individual was drawing in its ray which was in contact with the larger heliazoan, and was thus drawing itself towards it. The larger animal, offering the greater resistance, did not appear to move. Five minutes from the time the ray first touched the other heliazoan, the two had come in contact,

whereupon a union occurred and immediately the two blended into one. The smaller animal appeared to flow into the larger, and to disperse itself through it in a manner which is common to all these animals, young as well as full grown, and which will be described later, when we reach a nearly mature heliazoan. Before the union of these two animals, they appeared alike, except in size and number of vacuoles; but shortly after the union, the granules in the protoplasm gradually moved towards the center of the animal, where they became more numerous, and instead of being evenly distributed throughout the granular protoplasm, now formed a central, more granular portion, with an outer, clearer and less granular zone. Three more rays were also developed, and the animal presented the appearance shown in Fig. 7, which, at this stage, would probably not be mistaken for any other species. Hundreds of individuals were to be found of this size and appearance, and hence it was not necessary to watch the development of this single individual longer, as other fields promised better results.

There was almost an unlimited supply of heliazoa intermediate in size between the two whose union produced the one just mentioned. They differed in no respect from one another, or from the two just mentioned, except a slight difference in size, and every gradation between them was to be found. Merely for the sake of filling up the gap which exists in regard to size between the two individuals whose union we just referred to, I will cite one example out of many which I have observed. Two similar individuals, slightly larger than the smaller (Fig. 26) of the two just united, were seen to come together (Fig. 22), and, as a result of their union, a heliazoan was produced, so nearly alike the larger (Fig. 25) of the two of the former individuals, that there was, practically, no difference between them.

Another field was now chosen, in which were a number of heliazoa, similar in all respects to the one representing our last stage (Fig. 7). I had not waited long before it was evident that two of these animals were gradually approaching one another, from some cause which I was unable to discover. When within a very short distance,—in fact, almost ready to meet,—there occurred a very singular movement on the part of both individuals—a movement which I can hardly account for—in which there was produced a swelling, as it were, in that part of the sphere of both animals (Fig. 8, 9) which was just about to touch the other, and by continued enlarging with increased rapidity, soon met one another, thus unit-

ing the two individuals much more quickly than they otherwise would have done. Immediately upon touching one another, the at first narrow neck uniting them rapidly enlarged (Fig. 10), the protoplasm of the one flowing into the other, and *vice versa*, until the two animals had united into an oblong-shaped mass. The flowing of the protoplasm from one to the other was a most interesting sight, and could be distinctly seen, owing to the numerous granules which it contained. Both animals played an equal part in the union; a current of protoplasm could be seen streaming from the first into the second, and near it another current from the second into the first. There were as many currents as there were threads of denser protoplasm uniting them. Like all the observed cases, the denser and more granular portions of the protoplasm separating the vacuoles from one another never mixed with anything but the corresponding protoplasm of the individual with which it united; hence there was no destruction of vacuoles, but merely an addition or union; and, moreover, the peripheral layer of vacuoles always remained on the periphery, while the central mass of vacuoles flowed to the center of the united mass. The heliazoan now gradually changed from the oblong or ellipsoid shape to that of a sphere (Fig. 11), and here I left it, to seek other fields.

A nearly identical individual to the one just mentioned was found and seen to capture by one of its rays another but smaller heliazoan. As a result of a movement of the water, the smaller individual chanced to come in contact with the tip of a ray of the larger animal, and there to unite with it, whereupon the larger heliazoan gradually drew in its ray and the smaller creature with it. It was an interesting sight to see this process. The ray seemed rather to flow into the spherical mass or body of the animal, since a stream of protoplasm was rapidly and constantly flowing down its center into the animal, and the smaller heliazoan was likewise flowing into the larger by this means; but, nevertheless, the ray grew shorter and shorter, until, finally, the heliazoa came in contact (Fig. 13), and then a union took place similar to the one described above, except that here the flow of protoplasm appeared to be solely from the smaller to the larger animal. Before the animal had become entirely spherical, the denser inner portions of the smaller heliazoan had united with that of the larger and appeared as a swelling upon it, while the peripheral zones of both animals had united. This offered to be such a good example of the mode of union of the protoplasm of two heliazoa that I figured it (Fig. 15).

I have observed a number of large heliazoa capture the youngest individuals, and in all cases, as soon as the young animal touched the ray of the larger, it appeared, so to speak, to form a part of it, and would sometimes assume an oval form and remain on the ray, looking exactly like the little knobs of protoplasm which are frequently seen there, except that it would be larger; and then, again, I have seen them flow down the center of the ray, while the ray itself suffered no appreciable change. In one instance, however, which came under my observation, a moderately sized heliazoan (Fig. 17) captured by the tip of its ray one of the youngest individuals (Fig. 16), and while watching to see what would happen to this young one, the ray of a large heliazoan (Fig. 18) came in contact with the larger of the former animals. Out of curiosity merely, I watched to see the result of this extraordinary union, and found that the largest heliazoan drew its captured brother to itself and united with it before the smallest individual had touched the body of the one to which it was attached. The smallest heliazoan then appeared to be fastened to a ray of the largest animal, which, however, soon drew it to itself and the two united.

Quite a different process from the one we have been discussing occurs when the heliazoan encounters food consisting of other animals or plants. I have no doubt but that the youngest heliazoan, as well as those of all stages, are able, and generally do, develop and reach maturity by the use of no food other than that of other animals and plants; but there is also no doubt that this is a process requiring considerable time as compared with that which occurs when they chance to meet with their own kind, since in the former case the food has to be digested, while in the latter it has not. It was my good fortune to find a large heliazoan which had just captured an infusorium and partly surrounded it. In a few minutes the infusorium was completely enclosed, a clear space remaining around it, however, and gradually it was moved near the center of the animal, where it could be seen slowly moving its cilia in the little water which immediately surrounded it, and which separated it from the protoplasm of the heliazoan. (Fig. 19, 21.) Presently an amœba came in contact with the heliazoan and appeared to stick to it more or less, and to constantly try to move away from it. The heliazoan made several efforts to surround it, but the amœba in every case moved out before fairly imbedded, and finally, after several minutes of hard struggling to ascertain which was to be victorious, the amœba escaped. It was but a short time,

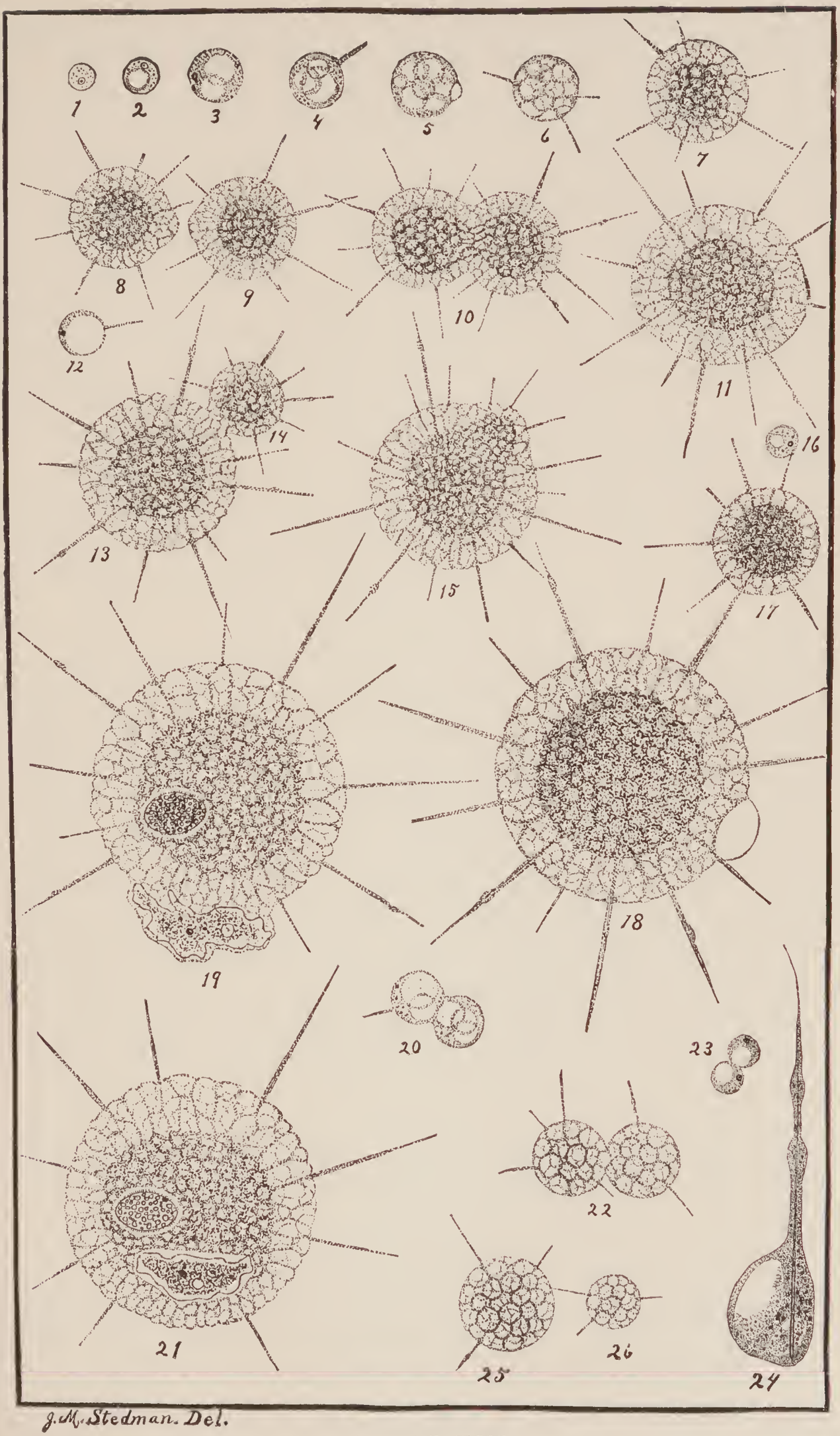
however, before another amœba chanced to touch the heliazoan, and this time with better success to the heliazoan. The amœba, as soon as it touched the heliazoan, spread out a little on it, and at the same time the protoplasm of the heliazoan began to flow around and to enclose the amœba, which now made several efforts to escape, but in vain, for within a few minutes a fine film of protoplasm had surrounded it, and the amœba was within the heliazoan, (Fig. 19). A quantity of water was also enclosed with the amœba, and in this it exhibited considerable activity, even after it had been carried nearly to the center of the heliazoan, (Fig. 21.) It was not long, however, before the amœba had assumed a globular form and become motionless. I mentioned this instance in which the heliazoa eat other animals merely to bring out the striking difference between the process and that observed when they eat their own species.

Dr. Joseph Leidy* speaks of having found several globules of granular protoplasm, with vascuoles and rays, and alludes to their probable connection with this species of heliazoa. I have reproduced in Fig. 24 one of his figures of these bodies, and think that there is every reason to believe that they are what he suspected them to be.

REPRODUCTION.—It is not uncommon to find heliazoa in the process of reproduction by fission. In fact, if heliazoa be kept for any considerable length of time, they are almost certain to be found in the act of reproducing by this means. I have observed them divide by keeping them in a watch-glass under the microscope, and in one instance I watched uninterruptedly the process from an oval heliazoan before the constriction began to appear, up to the division and entire separation into two animals. A complete set of drawings was made to illustrate the different steps, and I find, by referring to my notes, that one of the drawings is almost identical with Fig. 10, which represents the heliazoa in the process of union.

As regards reproduction in the heliazoa outside of the well known process of fission, all I can say is from a philosophical standpoint, as no direct observations have been made outside that of the finding of the young. But the presence of young has got to be explained in some way. From Dr. Leidy "Fresh-water Rhizopods," p. 260, I find that "according to Stein, Carter, and other authorities, A. Eichhornii contains many nuclei, large individuals having a hundred or more." Whether this has any connection with the heliazoan having devoured individuals of its own species and thus to have

* "Fresh-water Rhizopods of North America," p. 262-3.



J. M. Stedman. Del.

PLATE XIII.

retained their nuclei, and so by continually adding to the number every time it captured another heliazoan, to have finally attained the number of one hundred, or whether it is connected with the process of reproduction, I cannot say. It seems to me very probable that, in the fall at least, the full grown heliazoan becomes encysted, and that its protoplasm then divides and subdivides, until it is converted into a mass of minute bodies which, when the cyst is ruptured, make their escape into the surrounding water, and then appear as naked, spherical masses of granular protoplasm with a nucleus. It may be that the minute bodies acquire a covering before they escape from the mother cyst, and that they then act as spores, and are carried about and develop similar to the spores of infusoria.

Of course this mode of development has never been observed in the heliazoa, but it seems to me to be very probable that it does occur, judging from the observed young individuals and from the fact that it occurs in certain infusoria.

CORNELL UNIVERSITY, ITHACA, N. Y., 1888.

EXPLANATION OF PLATE.

All the figures were drawn from life, except figure 24, which is a reproduction of a figure from Dr. Leidy's work on the Rhizopods. Fig. 1, which is a heliazoan, *Actinosphærium eichhornii*, of the very youngest stage, is, in nature, 14.5 μ in diameter. The other figures are drawn with the same magnification as Fig. 1, and hence they all bear the same relative size in nature as is here represented, excepting Figs. 25 and 26, which are a little too small. I take it to be of much more value to the reader to have the figures drawn so as to preserve their relative size, and then to know the natural size of one of them, than it is to have the figures of various magnifications and know the magnification of each separate figure.

I do not wish it understood that the figure taken from Leidy is relatively of the same size as the other figures.

THE MUSCULAR COATS OF THE ŒSOPHAGUS OF THE DOMESTICATED ANIMALS.*

LEONARD PEARSON.

HISTORICAL SKETCH.

HUMAN anatomists are agreed that in man the muscular coat of the œsophagus is composed of two more or less regular and distinct layers, *i. e.*, an external longitudinal and an internal circu-

* Abstract of a paper read before the American Society of Microscopists, Columbus meeting.

lar. The longitudinal layer is described as originating from the ridge on the dorsal face of the cricoid cartilage, and from the inferior constrictor of the pharynx, while the circular layer comes from the inferior constrictor of the pharynx alone.

From Gillette (7),* we find that these layers are not as regular as would be inferred from the descriptions. In the pharyngeal part of the œsophagus, the longitudinal layer is thinner and more uniform than in the gastric part, where it is somewhat separated into bundles, and of these "some are parallel, some inter-cross, some divide and anastomose with each other. This inter-crossing and anastomosing takes place not only superficially, but also below the surface; that is to say, the ectal fibres become ental, and *vice versa*. In certain places a complete and almost inextricable entanglement is found."

With respect to the circular layer, the same author says that the fibres are not arranged in a regular manner. "There are complete and incomplete rings, sometimes inter-crossing at a more or less acute angle, and enclosing between them fibres that connect one ring with another."

The veterinary anatomists, presumably following the human anatomists, for a long time described a similar arrangement of the œsophageal muscles in the domestic animals. Gerardus Blasius (2) in 1681 described the arrangement of the muscle fibres in the œsophagus of the dog as follows: "The fibres are divided into two spirals, which meet in definite places, on the anterior and posterior walls, and intersect each other so that one goes under the other. They intersect by turn, so that the right seeks the left and the left the right. What constituted the external tunic becomes the internal, and again the external."

This arrangement, described by Blasius, is not found mentioned by any other author.

Leyh (12), in 1859, said that there were two muscular coats of the œsophagus: an external longitudinal, and an internal circular. He did not mention any difference as existing between the horse and the ox.

Strangeway (17), 1870, also divided the muscular coat into two layers, the external being composed of longitudinal fibres, and the inner of "spiral or circular" fibres.

Chauveau (3), in 1872, makes it evident that these coats are not

* The number in parenthesis following an author's name refers to the bibliography at the end of this paper.

entirely distinct, as he says that toward the inferior extremity of the canal they inter-cross in an almost inextricable manner.

In 1868, Klein (11) described an exceedingly complex arrangement of the fibres in the dog. In the pharyngeal eighth, he said, there is an external longitudinal and an internal circular layer; in the next two eighths the fibres of both layers decussate obliquely and at right angles; in the next three eights there is an inner longitudinal and an external circular layer; in the next eighth there are three layers: an internal longitudinal, a middle circular and an external longitudinal, the last mentioned layer being derived from the other two. In the last, or gastric eighth, there are also three layers: an internal oblique, a middle transverse and an external longitudinal. Klein does not say how these results were obtained, but from the figure it is evident that his conclusions were drawn from the study of transections.

Gillette (7) made a study of the "muscular tunic of the œsophagus in the animal series," and these briefly were his conclusions: In the dog there is no longitudinal layer. The superficial or ectal layer is composed of circular or elliptical fibres that cross on the dorsal wall in such a way as to represent a raphe. The second layer is subadjacent to the first, and is composed of fibres that have a direction opposite to the first, which they cross at an acute angle. A third very thin coat is mentioned. In the cat there are two layers, and the longitudinal arrangement is shown only in the caudal or gastric end. In the sheep there is no longitudinal layer, and the muscular tunic is composed of an entanglement of fibres that present no regularity. In the ox the arrangement is similar to that found in the sheep. In the horse there are two thick longitudinal bands of fibres extending one on each side, from the pharynx to the junction of the middle and gastric thirds. Between these longitudinal bundles, and springing from them are annular bundles that cross at a "raphe" on the dorsal wall and become mixed on the ventral wall. In the caudal third the regularity has disappeared. Two internal columns were seen, corresponding to those on the surface.

Franck (5), in 1883, described another system as existing in the horse. He says, in substance, that there are two lateral bundles, as above, and from these the oblique spirals take their origin. Upon the ventral and dorsal wall is a scarcely noticeable seam where the spirals come together. This constitutes the ectal layer. The ental layer is thinner, and its spirals cross those of the ectal at an acute angle. In ruminants the muscular arrangement is in reality as it is

in the horse, but no longitudinal bands are present. There are two layers of flat spirals, which cross at an acute angle.

Both Franck and Gurlt (8) call attention to the fact that fat is frequently deposited between these spirals.

ARRANGEMENT OF THE FIBRES.*

HORSE.—The muscular coat of the œsophagus commences in the horse at the caudal part of the pharynx, by two small bundles given off from the inferior constrictor of the pharynx, and by two bands arising from the caudal border of the arytenoid cartilage (anthors.) From these fibres two layers are formed, but they cannot be styled ectal and ental, as fibres that are at one place ectal are at another place ental, and *vice versa.* The fibres of the two layers form two spirals, which run in opposite directions around the œsophagus. Upon the dorsal and ventral walls the two spirals decussate. Those fibres that were ectal up to this time become ental, and the ental become ectal. It is, therefore, evident that in each passage around the œsophagus one-half of the length of the spirals are ectal and the other half ental. On the ventral wall the spirals, in meeting, form an angle with the apex pointing toward the stomach, while on the dorsal wall the apex, of necessity, points towards the pharynx.

Some of the fibres that are ectal unite on the ventral and dorsal aspects to form two longitudinal bands that extend from the pharynx two-thirds of the distance to the stomach. At this point their fibres become lost in the spirals, which gradually become less regular, until the typical spiral arrangement can be seen in but a few places. The longitudinal bands do not remain in the meson and cover the line of decussation at all points, but in places becomes more lateral.

SWINE.—In the hog the muscular coat is also made up of two spiral layers, which decussate upon the ventral and the dorsal walls. The line of decussation is quite distinct upon the dorsal wall for the first one-third. On the ventral wall for the same distance, the place of crossing shows only in part, as some of the fibres do not cross at this point, and by passing over, the line of decussation is hid from view. By removing these fibres, the crossing place can be plainly seen. Canded of the first one-third until 8–12 cm. from the stomach, some of the fibres become very much inclined, and extend longitudinally along the dorsal and ventral aspects of the œsophagus, covering the line of demarcation.

* The following discussion does not refer to the *Muscularis mucosæ.*

As before, this can be seen by removing the superficial fibres. In the 8–12 cm. next to the stomach, the ectal fibres become more nearly perpendicular to the longitudinal axis of the œsophagus, while the ental fibres retain the former inclination of about 45°.

SHEEP.—In the sheep, where regurgitation is a normal and frequent act, it might be supposed that there would be a well-developed longitudinal layer of muscle, but such is not the case. Even the longitudinal bands found in the horse and hog are not present. The muscular fibres form two oppositely directed spirals, which cross one another on the dorsal and ventral walls. Both lines of decussation are quite well marked. Throughout the length of the tube the ectal fibres are only slightly inclined, but as soon as they become ental, their angle of inclination increases in the cephalic third to 65°, decreasing to 45° in the middle third, after which the ental and ectal fibres assume approximately the same angle with the meson—about 45°—and thus meet each other at a right angle. In the last 2–5 cm. the ectal fibres become almost longitudinal before extending upon the stomach.

At many places in the length of the œsophagus small offshoots take their origin from an otherwise regular bundle of fibres. These offshoots pursue an irregular course, sometimes extending longitudinally for a few centimeters, and then dipping down and continuing in the regular course, or they may simply be inclined at a different angle from the other fibres of the layers.

OX.—The disposition of the muscular fibres in this animal is very similar to the arrangement found in the sheep, but there are some constant differences. In the pharyngeal third it looks as though the fibres regularly encircled the œsophagus, but by removing the superficial layers upon the dorsal and ventral walls, the lines of decussation can be seen. The ental fibres in the pharyngeal third have an inclination from the longitudinal axis of about 30°. As soon, however, as they cross and become ectal, they assume a direction nearly perpendicular to the axis. As the ectal fibres approach the line of decussation, some, instead of passing under the bands from the other layer, pass over, and thus cover the crossing place. It is to this fact that the annular appearance is due. Continuing toward the stomach, the ectal fibres become less inclined to the axis, while the inclination of the ental fibres increase, so that at the junction of the middle and gastric thirds, each layer has an inclination of about 45°, and thus continue to the stomach.

As with the sheep, there are irregularities in places, and these are of much the same nature as in the sheep. Longitudinal bands

may extend along the surface for a few centimetres, or some fibres may take an inclination differing from that of the spirals. None of these offshoots extend far, and if they belong to a regular system the connection was not discovered.

DOG.—In the dog the arrangement of the muscular fibres is more regular and uniform throughout the length of the tube than in any other animal examined. As before, two spirals are found that decussate upon the dorsal and ventral walls. The lines of decussation are distinct for their entire lengths. At the beginning of the œsophagus the ectal fibres have an inclination of about 72° to the longitudinal axis, but upon crossing the line of decussation and becoming ental, they turn cephalad or caudad at such an angle as to make their direction at right angles to that of the fibres covering them. The directions of the fibres gradually become equalized until both have an inclination of 45°.

There are at the gastric end a few small bundles following a course differing more or less from the regular one. These bundles all pass to the stomach, and are the only signs of irregularity in the tube. If transections were made at this point, and descriptions based upon them alone, it would be easy to repeat Kline's error and say that at the caudal end of the œsophagus there are three layers of muscular tissue. The so-called third layer exists only where a bundle of fibres pursues an erratic course.

CAT.—In this animal the spiral arrangement is again found, but not in the entire length of the tube. The ectal and ental first cross at an angle of 150°, which gradually decreases to 90°. This decrease is occasioned by the ectal fibres becoming more nearly longitudinal and the ental more nearly circular.

In the caudal one-third or two-fifths, the ectal layer becomes approximately longitudinal, and the ental is circular. The two layers are here in no way connected. The circular layer is not spiral in character, nor are the fibres grouped into distinct rings, but it is a uniform sheet encircling the caudal part of the tube. In the caudal one-third, there is no crossing of fibres, which ceases, of course, when the spirals become distinct from each other.

The œsophagus of the cat is peculiar, in that the longitudinal and circular plan is more largely developed than in the other domestic animals. In the sheep this arrangement also exists in the gastric end of the tube, but for a shorter distance.

SUMMARY OF ARRANGEMENT OF FIBRES.

1. The muscular coat of the œsophagus is divided into two layers.

2. These layers cannot be designated longitudinal and circular.

3. These layers cannot be designated ectal and ental.

4. Fibres that are on one side ectal are on the other ental, and *vice versa.*

5. If longitudinal and circular layers exist with any regularity, it is only in the gastric end of the tube.

6. The typical arrangement may be thus described. In the walls of the œsophagus there are two layers of muscle fibres, arranged in spirals. These spirals are wound in opposite directions around the tube. Upon the dorsal and ventral walls they cross each other, by dividing into small bundles which interdigitate, the ectal becoming ental, and the ental, ectal.

MICROSCOPIC ANATOMY.

[The following discussion does not refer to the *muscularis mucosæ.*]

The first feature that impresses one upon making a microscopic examination of the muscle of the œsophagus is, that in some of the domesticated animals a part of the tissue is composed of striated, and a part of unstriated fibres. In brief, the relations of the two kinds of muscles are as follows:

In the horse, non-striated fibres begin with the gastric third and increase in number approaching the stomach, but a few striated fibres continue to the stomach.*

In the pig, non-striated fibres begin to appear 12–18 cm. from the gastric extremity, and increase is number to the stomach, but, as before, some striated fibres continue to the stomach, and in this case are much more abundant.

In the sheep, ox and dog, no non-striated fibres are found cephalad of the diaphragm.

In the cat, when the ectal fibres first become longitudinal, the non-striated fibres begin to appear, and soon they alone are found. In the ental or circular portion, the non-striated fibres appear at the same level and sooner exclude the striated.

TERMINATIONS OF FIBRES.

In every œsophagus examined, fibres gradually tapering to a point were found. They were present in nearly all of the preparations examined, showing this to be an exceedingly common method of ending. Near the end of the fibre there is a marked swelling, and at this point a large nucleus. Just before making this expan-

*This was true of the only horse's œsophagus examined microscopically.

sion, the striæ fade away, and the material in which the nucleus is imbedded, as well as the fibre beyond, is clear, except a few granules.

In the sheep, ox, dog and pig, fibres frequently taper to within 2 mm. from the end, when lateral branches are given off at intervals for the rest of the distance. Sometimes there is but one such branch, and sometimes as many as five (ox). These branches may be given off before the striæ cease, in which case they are striated themselves, and end in a swelling and nucleus, as above, or they may be given off at the swelling, when they resemble in appearance the tip of the fibre. In the latter case the branches are very short. These tapering ends are applied to another fibre at a place where it is of full size (6). The end seems to be retained in this position by a sort of cell cement. No connective tissue has been noted adhering to an end of this kind.

In the ox, there is a kind of ending where, although the fibre tapers, it does not come to a point. When a diameter of about .01 mm. is reached, a blunt end is formed, and connective tissue fibres extend from the ends and sides of the ending along the side of an adjacent full-size fibre for a distance of about .2 mm. This condition was seen distinctly in but two cases.

In the pig, only, were fibres found to end without first becoming narrower, although tapering ends were also plenty. These endings are of two kinds: In the first case, the branches are all near the end, and may all be considered as terminal and in the second case there is a thick lateral branch, after which the fibre tapers and gives off small branches as an ordinary tapering end.

In the first case, the condition may be compared to the end of a tree trunk that has been blown down and is shivered at the point of fracture. At the end of the fibre are two to six branches that separate into so many small branches as to resemble a brush. While all of the primary branches may not arise from the end of the fibre, they spring from the sides very near to the end. The primary branches are striated, and the striæ show for part of the length of the secondary branches, when they fade out, leaving the apex clear. How a fibre of this sort is attached to another I was unable to determine. It does not seem at all likely that such a thick end would be an overlapping end, and nothing was seen to favor this view. All of the endings of this character found were surrounded by more or less connective tissue.

In the second class a large branch is given off .15 to .2 mm. from the end of the fibre. This branch is short and simple, and is divided at the end like the fibres of the first-class. The branch is

sometimes of half of the diameter of the fibre from which it is given off. The remaining portion, as was said, continues like an ordinary tapering end of the branching variety. This branching tapering end is applied to the surface of a full-sized fibre, as are the tapering ends described above. I was unable to determine the connections of the thick branch. Like the endings of the first class, there was always more or less connective tissue adhering to its end and sides. Where the striated and unstriated fibres join, the former terminate in an unbranched, tapering end that is surrounded by unstriated muscle cells joined to it by means of cell cement. (Bib. 6.)

METHODS.

To soften and remove the connective tissue so that the muscle fibres could be easily separated, three methods were employed:

1. Boiling in water.

2. Macerating in 20 per cent. nitric acid. The œsophagus should be filled with the acid and the ends tied, then suspended in a long jar of the same liquid. It is necessary to allow it to remain thus from six hours to three days, depending upon the temperature.

3. Heating in 5 to 10 per cent. nitric acid (HNO_3). This method is used when it is desired to study the specimen at once.

The first method was useful only in the gross anatomy, and even in this case was not as satisfactory as the methods following. Boiling enough to make the fibres easily separable sometimes renders them friable. If the second or third method is used, the material must be perfectly fresh, for it is found that otherwise the muscular fibres will soften before the connective tissue. After treatment with nitric acid the muscle was found to continue to soften if kept in water or alcohol. Prof. Gage found that this softening could be prevented by keeping the tissue in a saturated aqueous solution of alum. Before the immersion in alum-water, the fibres cannot be satisfactorily stained, but after remaining in this solution for a few hours, hæmatoxylon stains them excellently.

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ITHACA, N. Y.

PROCEEDINGS OF SOCIETIES.

THE IRON CITY MICROSCOPICAL SOCIETY.

THE Iron City Microscopical Society held its regular monthly and annual meeting for the election of officers and transaction of similar business, at their headquarters in the Pittsburg Library rooms, October 23d, 1888.

Mr. Mellor, the President of the Association for the last three years, called the meeting to order, and announced that the first business before the Society would be the election of officers for the ensuing year. In that connection he stated that he thought he had served his full time in an executive capacity, and that he should be released from further duty in that line. He must, therefore, decline another term in his present office, but assured the members that his interest would be even more active than heretofore, and that he would give all of the assistance possible to the new officers.

He then briefly reviewed the past history and present condition of the organization, and gave expression to some hopeful ideas as to the future scope and extent of its work.

The following were then elected: President, Rev. W. J. Holland, D. D., P. M. D.; First Vice-President, Prof. James M. Logan; Second Vice-President, C. C. Mellor; Recording Secretary, Dr. H. DePuy; Corresponding Secretary, George M. Clapp; Treasurer, C. G. Milner; Curator, Herbert Walker.

In taking the chair, Rev. Dr. Holland thanked the Society for the honor conferred upon him, and expressed the diffidence he felt in venturing to follow in the footsteps of the retiring President, who had proved, during the last three years, that he was so eminently fitted for his position. He continued:

"Nothing but the assurance that we shall continue to have the help and co-operation of the retiring President has influenced me to consent to my nomination. In taking the chair I desire to emphasize a point which he has touched upon. That is, the desirability of enlarging the scope and purposes of our body—in fact, making it the initial point for a grander enterprise. Pittsburg and Allegheny are rich in brain and talent as well as in wealth. Why should we not have an academy of sciences which should unite in that fellowship and co-operation which we have found so pleasant, not only those who are devoted to the art of microscopy, but those who are cultivating the great sciences to which the use of the microscope is simply subsidiary. We have chemists, electricians, astronomers, botanists, ornithologists and geologists in the present ranks of the Society. Why not through these, our brethren, reach forth and draw into the larger society, of which our shall form a section, the the great body of thinking men among us, many of whom have a more than local reputation? If Philadelphia, when half the size of this community, laid the foundation of an academy of sciences, the fame and power of which is world-wide, why should not we? If

Buffalo, Cleveland and Cincinnati support such institutions, why should not Pittsburg and Allegheny?"

The regular meeting night was changed to the second Tuesday of each month, in order to accommodate the members who belong to the Allegheny County Medical Society. It was also decided to give a public soiree next month, with the object of securing funds for the purchase of scientific equipments for the Association.

The business meeting was then adjourned, and the examination of specimens resumed. Among the objects shown were *stephanoceros eichhornii*, and also a polyzoa, or coral-like animal—*alcyonella*—both from a pond near Edgewood. Also, *cyclosis* in *chara;* stained section of human scalp; blood corpuscles, with a number of zoophytes and other similar objects.

THIS Society held its monthly meeting Tuesday evening, November 13th.

Mr. C. C. Mellor read an interesting paper on an interesting rotifer, "*Stephanoceros Eichornii.*" Mr. Mellor had exhibited the rotifer at the preceding meeting; the paper was illustrated by many drawings.

Rev. W. J. Holland exhibited a specimen of what he considered to be a species of anobium; this animal was found feeding upon the intestines of a Goliath beetle, and lived 48 hours in an atmosphere of hydrocyanic acid.

Among other exhibits were: Section of basalt from Bridgeport, Conn., seen by polarized light; sponge spicules; crystals of guanadine; section of lower jaw of pup; *aspergillus niger*, or mould fungus from diseased human ear.

A committee was appointed to consider the advisability of securing a charter for the Association.

GORDON OGDEN.

RICHMOND MICROSCOPICAL SOCIETY.

EXTRACT FROM THE MINUTES OF THE RICHMOND MICROSCOPICAL SOCIETY'S REGULAR MEETING OF NOVEMBER, 1888.

THE paper of the evening was by Thomas Christian, Esq., describing some of the many rare diatoms found in the fossil marine deposit from Oamaru Otago, New Zealand. Mr. Christian illustrated his lecture by a full set of skillfully mounted slides on which he had picked and selected single named diatoms showing the rare and type-forms carefully gathered from the deposit by the lec-

turer, while preparing a list of the diatoms found. These diatoms have been beautifully illustrated by exquisite engravings in the Quicket Microscopical Club Journal, of London. Many of these new and rare forms were discovered here before they were described in Europe.

The following are the names of the diatoms exhibited, and of which Mr. Christian has duplicated slides of the rare forms, viz:

Navicula sparsi punctata, N. interlineata, Biddulphia elaborata, B. damanuensis, B. virgata, B. punctata, B. reversa, Ceratanlus subangulatus, Triceratum foseinoides, T. kinkerianum, T. venulosum var. major, T. dobreeanum var. nova Zeelandica, T. cancellatum, T. spinosum, T. capitalum, T. parallum, T. farvus var. quadrata; also, *T. F. maxima, T. arcticum,* quadrangular form, *T. intermedium, T. lineatum, T. crenulatum, T. morlandii, Eunologramma Weissii;* also, two forms *E.* not yet described; *Aulacodiscus cellulosus, A. S. var. nova Zealandica, A. notatus, Auliscus oamaraensis, Actinoptychus vulgaris var. maculata, Hermialus ornithocephalus, Biddulphia vittata, Aulacodiscus garuschii, A. rattragii, A. elegans, A. Huttonii, A. rodiosvs monopsia mammosa, Pycilla reticulata, Actinoptichus elegantatus, A. var. tenera, Tunacira similacrum, Melosira omamensis.*

The meeting, in appreciation of the highly interesting lecture and exhibit of Mr. Christian, expressed thanks in an appropriate resolution, acknowledging the high attainments of Mr. Christian as a scientist on the broad field of microscopy, and one who, in his specialty as diatomist, ranks among the most distinguished authorities in this branch, on this continent.

G. A. PEPLE,
Secretary.

AMERICAN POSTAL MICROSCOPICAL CLUB.

BOX E^2 is one of great interest to physicians. Slide No 3 contains a large number of finely mounted "feather crystals" of uric acid abstracted from the blood of the caterpillar just going into the pupa state. The slide was prepared by Prof. Samuel Lockwood, of Freehold, N. J., and the *modus operandi* is thus explained:

"Owing to the large amount of chlorophyll consumed in the flood, the blood of the lepidoptera larvæ is of greenish color. Having got an adult caterpillar, that is, one that is just going into the pupa state, take at least six chemically cleaned glass slips, puncture the caterpillar on one side and put a drop of the green fluid on

the slip, spread it out thin, but not too thin; set the slides in a place with a temperature not lower than 78° F., and cover so as to exclude dust and light. As soon as the blood is dry the crystals will appear.

"Crystals of urea are dissolvable by the moisture of the atmosphere, so that it is necessary to mount them without delay as soon as the blood has sufficiently dried. The mounting of the urates can be deferred longer before completing. The crystals are mounted in balsam, and should be viewed with polariscope."

In the comments upon the slide, Mr. C. M. Vorce says: "The slide contributed by Pres. Lockwood contains crystals of almost exactly the form of ammonio-phosphate of lime and magnesia from the urine of mammals; the feathery form of the crystals indicates, under the conditions stated, that other salts besides urates are present in the fluid.

"The *uric acid* crystals of lepidopterous larvæ at about the time of pupation can be obtained from the secretion of the uriniferous tubes, which are large and easily recognized at that period.

"By dissecting out the tubes under alcohol and putting them in water on the slip, and tearing them apart, their contents dissolve in the water; on removing the fragments and stirring the water with a toothpick moistened with muriatic acid, a mass of crystals will be deposited which polarize with remarkable brilliancy."

Slide No. 6, prepared and contributed by Eugene A. Rau, of Bethlehem, Pa., is of trichinæ spiralis muscularis; a clinical history of the cases is given and the result of autopsies made upon the subjects who had died of the disease. Excellent micro-photographs accompany the description.

ELEMENTARY DEPARTMENT.

RUDIMENTS OF PRACTICAL EMBRYOLOGY.*

W. P. MANTON.

SECTION VI.

LABELING—SLIDE CABINET.

§ 15. Any kind of a label desired may be used. That which I find most convenient, however, consists of rather thick white card-board, cut half an inch wide by an inch long. On one of these is printed the name of the microscopist, below which the place of

*Copyrighted 1888.

mounting, and date, are filled in with ink. At the upper left hand is placed the *series* of the slide in Roman numerals, while just below it, in Arabic numerals, is the *number* of the slide in the series, thus: "Series XVI, Number 1." This is also done with pen and ink. On the label on the other end of the slide should be written the kind of section—that is, transection, longi-section, etc.—the age, and kind of embryo, and finally the hardening, staining and mounting agents which have been employed.

For securing these labels to the glass, Le Page's glue will be found excellent. As these labels project sufficiently above the cover-glass to protect it from injury, several of the slides may be piled together and set aside while drying.

While mounting a series of slides, I am accustomed to note the series and number of slide on the back of the latter with ink, so that labeling may be postponed until the series is completed.

For a slide cabinet, I have had made a stong pasteboard box with hinged front, holding ten pasteboard trays. Each tray is divided into three compartments, which hold nine slides each, thus giving twenty-seven slides to the tray and two hundred and seventy to the box—a number which the beginner will be long in making. For it must be remembered that all eggs put to incubate will not prove fertile, neither will all slides prepared be found worth preserving.

A COURSE IN ANIMAL HISTOLOGY.

FRANK W. BROWN, M. D.

SIXTH PAPER.

RETIFORM TISSUE.—Take a small piece of umbilical cord at the fifth month (although a cord at any stage of its development may be used), and harden in Müller's fluid, after which it is to be placed in 95 per cent. alcohol for a time. It can then be embedded in celloidin and sectioned. If the worker is not familiar with the use of celloidin he may proceed as follows: Put the specimen in water until the alcohol has been withdrawn. Now make a solution of gum arabic in glycerin to the consistency of thick honey. This can best be done by first making a stiff paste of the gum with water and then adding the glycerin. The specimen is now placed in this solution until it becomes thoroughly infiltrated and sinks to the bottom, when it is removed to stronger alcohol. The alcohol removes the glycerin, for which it has an affinity, and precipitates the gum

around and in the specimen, which can then be cut without difficulty. The sections are then placed in water in order that the gum may be dissolved out, when they are ready for staining. Stain with hæmatoxylin and mount in balsam or glycerin.

In the spongy portions of the cord, small masses of retiform or reticular tissue may be studied. This tissue is a form of fibrous tissue arranged, as its name denotes, in a network, composed of rather cylindrical bundles of small fibers. At the various points where the bundles seem to cross, a connective-tissue cell is generally found. This cell is flat and stellate. Careful teasing will remove it from the fibers on which it is placed. Thus isolated it can be studied to the best advantage. It possesses a large, oval nucleus and has a slightly granular appearance. The fibers composing the network can be separated by teasing out a specimen which has remained for some time in Müller's fluid. They are quite similar to the fine fibers of fibrous tissue already described.

ADENOID TISSUE.—This form of connective tissue can be best studied in the lymphatic glands, where it is found in a pure state. Harden such a gland, preferably one from an ox, in Müller's fluid and alcohol, make cross sections, stain lightly in hæmatoxylin and mount.

The tissue will be seen to be composed of a very fine meshwork, the interstices of which are packed with lymphoid cells. The meshwork is quite similar to that of reticular tissue, in fact a perfect distinction between the two is impossible. The network is composed of fibrils which are given off from thick trabeculæ, which traverse the tissue in more or less parallel bands. These trabeculæ are derived from the inner fibers of the capsule of the gland.

The connective tissue corpuscles are found in the same position as those of reticular tissue. They can be penciled off and studied separately. The network can be best studied in a specimen which has been agitated for some time in a test-tube half full of water. This removes the greater number of lymphoid cells and allows of a clearer view of the framework. The lymphoid cells are quite identical with the leucocytes of the blood. When isolated from living tissues they sometimes show amœboid movements. Each contains a well-defined nucleus embedded in a granular cell body.

GELATINOUS TISSUE.—This is essentially an embryonal tissue, and is only found in the adult in the vitreous humor of the eye where it is much changed from its embryonal form. The umbilical cord contains large quantities of the pure tissue, where it can be studied in a

specimen prepared as described in the beginning of this paper. It is the simplest form of connective tissue, and is composed of a structureless jelly-like basement substance, in which are embedded a number of rather large irregular or spindle-shaped cells. These cells are nucleated and are joined to each other by means of their processes, thus forming distinct networks.

NOTE.—As this tissue is the progenitor of fibrous connective tissue, into which it begins to change at an early period, it is best to study it in a cord taken as early as the third month of gestation. Even then a few delicate fibrils will be found in the basement substance, especially in the neighborhood of the cells, which also show faint markings preceding more or less complete fibrillation.

In the mature cord the fibrous tissue has become so abundant as to conceal in many places the identity of the gelatinous substance.

EDITORIAL.

THE AMERICAN SOCIETY OF MICROSCOPISTS AND THE WORKING SESSION.

A MOST superficial comparison of the last volume of transactions of the American Society of Microscopists with any of the preceding publications issued by that body, cannot fail to disclose the great advance made in scientific investigations and methods by its members. The masterly presidential address by Prof. Wm. A. Rogers, which alone covers the first one hundred and twenty-five pages of the proceedings, is a scientific benediction upon all that follows, and a guarantee that succeeding pages are at least worthy to bear it company. A glance through the various pages will convince any one that the Society is doing a good and valuable work in the field of science, and that to-day it well deserves the position which it has so fairly won for itself among the leading scientific bodies of the world. With such testimony before us as is contained in this volume, it cannot be denied that the A. S. M. is fulfilling the duty which it imposed upon itself some eleven years ago on its natal day in Indianapolis. The Society has succeeded far beyond the most sanguine expectations, even of its founders; and yet, if we probe below this encircling crust of scientific results, we reach a point which indicates that in the perfect fulfilment of its original programme, the Society is greviously lapsing year by year. In the preliminary By-Laws submitted for the Society's action at Indianapolis, we read in

Article II: "The object shall be the encouragement of microscopical research in all branches of science, by meetings, discussions, demonstrations and the reading and publishing of papers." This, in the revised Constitution as adopted at Buffalo, appears trimmed down to "The object shall be the encouragement of microscopical research." In the original proposition the conditions expressed the most good to the greatest number; as it now stands it plainly indicates the most good to the chosen few. In framing the original article, the committee evidently realized the fact that the Society of which they then formed the nucleus, would not and could not be entirely composed of men and women whose tastes and training were thoroughly scientific. They therefore wisely incorporated into the article the word "*demonstrations*," knowing that to these members practical instruction would be of far greater interest than the most learned papers which the future might produce. It was not, however, until the sixth meeting of the A. S. M. that the importance of this department began to take definite shape in the minds of those most interested in the Society's welfare. We learn from the transactions of that year —1883, Chicago meeting—that Mr. E. H. Griffith had charge of the practical work, which consisted of twelve experts occupied with various methods in microscopy.

The favor with which this "new feature" was received is well seen by reference to the proceedings of the Rochester meeting (1884). Here, not twelve, but *twenty-eight* members demonstrated to their associates the methods which, in their hands, had given the best satisfaction. "To the labors of Mr. E. H. Griffith, under whose direction the session was conducted, very much of the success of this feature of the meetings may be attributed," say the transactions. At the Cleveland meeting, (1885), the session was under the able direction of Mr. C. M. Vorce, and the number of workers' tables had increased to thirty-eight, besides which, a large collection of photomicrographs, and several interesting and special instruments were exhibited. At the Chatauqua meeting, (1886), there were forty workers in the session, but owing to several reasons the affair was not wholly a success. At Pittsburgh, the number of workers dwindled to about eighteen, and although many valuable methods were demonstrated, the usefulness of the session was marred by the limited time given to the demonstrators. At the last meeting the working session existed only in name. *

Now what has been the effect of this decadence of practical

* An impromptu working session was held at the Columbus meeting, but it was of so unimportant a nature that it hardly deserves the name.

demonstrations of microscopical matters ? A gradual lessening of the number of attendance at the meetings, and a general feeling of dissatisfaction, in spite of the high character of the papers presented. From conversation and correspondence with different microscopists in various portions of the country, we feel quite sure that had there been promise of a successful working session at Columbus last August, the attendance at the meeting would have been more than doubled.

Indeed, so greatly is the decline of this department of the Society's labors regretted, that it has been suggested that a separate organization be formed, the work of which shall be practical demonstrations,—the how to do, without reference to the ultimate results of investigation. The establishment of another society would, in our opinion, be a grave mistake, and yet, if we read the signs of the times aright, such will be the consequence, if the A. S. M. does not bestir itself with reference to the working session.

The plan which appears to us would give most general satisfaction is the following : 1st, At each meeting, let some member who is known to be a good worker, and can and will carry out the work, be appointed chairman of the working-session committee ; this to consist of three members resident in the city where the meeting following will be held, and one other member of the society,—not a resident—who will heartily co-operate with the chairman and local committee. This fourth member shall be appointed with reference to his fitness and ability to succeed to the chairmanship of the committee at the second meeting following. This will always insure a chairman who has had some experience with the working session, and who ought, by observing the failures or mistakes of his predecessor, to improve the session over which he now presides.

2d. Let the W. S. committee appoint from six to twelve members, or more, experts, and who shall signify their intention of being present at the coming meeting, to demonstrate different methods in which they are known to be adepts, insisting that each demonstrator shall describe such practical work only as is set against his name in the programme. This will provide for a number of useful demonstrations, without leaving the matter to chance or the occasion; but that all who so desire may take part, extra tables should be prepared.

3d. In order that the full benefit of these demonstrations may be enjoyed by members, let the whole of the second day of the meeting —morning and afternoon—be devoted to the W. S.

In this way, those really desirous of learning microscopical technology will be enabled to go from table to table, carefully watching the demonstrators, asking questions and making notes. With a room full of workers, three hours is not sufficient for the enquirer to derive much advantage from what he sees. *It must carefully be borne in mind that the W. S. is not primarily intended for the expert, but for the amateur and beginner, who, having few or no opportunities at home for instruction in microscopy, makes a journey to the place of meeting solely for the purpose of learning.*

To us it appears that if some such plan as the above is carried out, the A. S. M. meetings will never lack in attendance; the treasury will always contain enough and to spare for the Society's needs, and the usefulness of this distinguished body of men and women will be greatly enhanced.

AT this season of the year, microscopical societies all over the country are beginning to plan their winter's work. As a sample of the way in which a successful society is conducted, we append the programme of the Iron City (Pittsburg) Microscopical Society. This association has been in existence seven years, has eighty-eight members, and property, including books, instruments and cabinet, valued at over seven hundred dollars. It is composed of some of the most scientific men in the country, as well as many others who are interested in microscopy, and at present is agitating the question of the establishment of an academy of science, of which it shall be a section.

PROGRAMME AT MEETINGS.

7:30 TO 9:30 P. M.

1. Exhibition of objects under the microscope. Each member is expected to bring his microscope and at least one object, with a brief descriptive card. Any object is acceptable, whether prepared by the members or others.

2. Occasional reading of papers on microscopical objects, which is optional with members.

3. Exhibition of books, drawings, photo-micrographs, apparatus or anything of interest connected with the history or progress of the microscope.

4. Practical illustrations of microscopical work, including the preparation and mounting of objects.

5. Business Session, 9:30 to 10 P. M.

6. Occasional excursions will be made on Saturday afternoon in the vicinity of Pittsburg by members and their friends, for collecting living and other objects for examination and investigation under the microscope.

ADMISSIONS AND DUES.

Any person interested in Microscopy may be proposed for membership. Initiation fee, $2.00, annual dues, $3.00. No member can withdraw until all arrears are paid. All dues are payable in advance.

No books can be drawn from the Society Library until dues are paid. Members wishing books will apply to Librarian of the Pittsburg Library, or to the Curator at the meetings.

TECHNOLOGY.

TESTS FOR MODERN OBJECTIVES.

MR. E. M. NELSON considers that the advance of the microscope in recent years is due to the *Podura* scale and the following diatoms: 1st, *Rhomboides:* 2nd, *Grammatophora subtilissima;* 3d, and probably to a greater extent, *Amphipleura pellucida;* lastly, and at the present time, to *Pleurosigma angulatum*, *N. rhomboides*, and the secondary markings of diatoms in general with large-angled cones of central light. It was the demand for glasses which would give classical images of the *Podura* scale which improved the central portions of the objectives, and it was the demand for diatom-resolving lenses which spurred on the opticians to make wide angles and to correct the margins. But however much we may regret it, these old tests, the *Podura* and the *Amphipleura pellucida*, which have been of great service to the cause of microscopy, must be laid aside. The classical picture of *Podura* demands such a very small area of the center of an objective that it tests too little of the glass. The following are a few tests for modern objectives:

1. *Pleurosigma angulatum*, showing dark perforations on a light ground, with a fracture passing through them. While the dioptric beam passes through the center of the lens, the diffraction spectra sweep the margin. Unless a lens be truly centered, it will not stand this test.

2. A Cherryfield *Rhomboides* in balsam or styrax, with the full aperture of Powell's latest condenser, is a very severe test.

3. To these may be added the secondary markings on diatoms, *e. g.*, *Coscinodiscus asteromphalus*, etc.

4. The fracture passing through the secondary markings, such as (*a*), *Triceratium;* (*b*), *Isthuria nervosa.*

5. The secondary markings of the ariolations on the *hoop* of *Isthuria nervosa* in balsam.

All these tests are intended for solid cones of direct light of various apertures. Two classes of tests are comprised in this list. The first, and perhaps the best, is the way a fairly large test is presented; 1, 2, 4 (*a*), and some of 3, are in this class. The other class consists in the possibility in making out the test at all; 4 (*b*), 5, and some of 3, are in this class.—*Journal of the Royal Microscopical Society.*

ABSTRACTS.

KORKUNOFF ON TUBERCULOUS ULCERS.—Korkunoff (Wratsch., No. 32, p. 612), having made a number of careful studies as to the origin of tubercular ulcers in the larynx, and the participation of the tubercle bacilli in the process, comes to these conclusions:

1. Careful search will always show the presence of the bacilli, though their number does not always correspond with the extent of the process.

2. The infection is never through the sputum, but rather through the lymph and blood channels leading from the affected lung.

3. The ulcers arise in this way: A small tubercle grows beneath the epithelial layers, from which it may be separated by connective tissue. Its approach to the surface is preceded by an infiltration of the epithelial covering with leucocytes. The bacilli now make their appearance. Necrosis of the epithelium takes place, and the ulcer is thus established from within outwards.

NEWS AND NOTES.

"SHOW me the investigator who has never made a mistake, and I will show you one who has never made a discovery."

UP to July, 1888, the Army Medical Museum contained 10,416 microscopical specimens.

DR. LEIDY says that the drum-fish seems, in some instances, to owe its flavor to a parasitic worm, *Acanthorhyncus reptans*.

DR. A. JULIEN and Prof. H. C. Bolton have discovered what seems to be the explanation for the phenomenon of singing or sonorous sands. These sands are quite clean, free from silt and and dust. When moistened, and the moisture is evaporated, a film of condensed air is formed on the surface of each grain, which acts as an elastic cushion, and enables the sand to vibrate when disturbed.

THE Rev. W. H. Dallinger, ex-President of the Royal Microscopical Society, has resigned the presidency of Wesley College, Sheffield, England, and will devote himself hereafter to research in bacteriology and other lines in which he is so well known. London will be Dr. Dallinger's future home, and he will there fit up a private laboratory.

BOOK REVIEWS.

PRELIMINARY ABSTRACT REPORT of the Marine Laboratory, Stationed in 1887 at Nassau, New Providence, University of Pennsylvania.

In this preliminary report, Dr. Dolley, the Director of the Laboratory, briefly presents the necessity of the study of marine fauna on the spot where specimens are taken, as the fragile character of marine invertebrates renders preserving them by means of reagents practically impossible. The success of this attempt on the part of the Biological Department of the University of Pennsylvania, has led to a representative being sent to Europe to the various marine laboratories, with the purpose of obtaining information in regard to the practical workings of these institutions, and we may expect at no late day to see this department, with a well equipped building, ready to receive students.

LAPAROTOMY FOR FIBRO-CYSTIC TUMOR. Recovery. By Chas. H. Merz, A. M., M. D. Sandusky, Ohio. Reprint.

CORRESPONDENCE AND QUERIES.

TO KEEP A SECTION-CUTTER KNIFE BRIGHT.—In your November issue I notice that some one desires to know how to keep the knife bright that is used in section cutting. I always wipe my knives perfectly dry and rub them with a cloth saturated with vaseline. I have never experienced any difficulty from rust.

GREEN STAINS FOR VEGETABLE SECTIONS.—Another correspondent asks for a better stain to use in double-staining wood sections than malachite green. Aniline green gives better satisfaction in the first place, but I fear it will not last long, as all the aniline dyes fade in course of time.

H. M. WHELPLEY.

ST. LOUIS, MO.

In answer to B.'s inquiry in the November MICROSCOPE in regard to keeping the microtome knife free from rust, the blade might be immersed for a few minutes in a saturated solution of carbonate of potassium. This has been recommended, but we cannot vouch for its usefulness.

D., New York, recommends thoroughly cleaning section knives, and then rubbing with a rag well smeared with mercurial ointment. Other things may keep it bright, but this is the only thing that will surely do it. Vaseline and its mixtures are very good but not infallible.

EXCHANGES.

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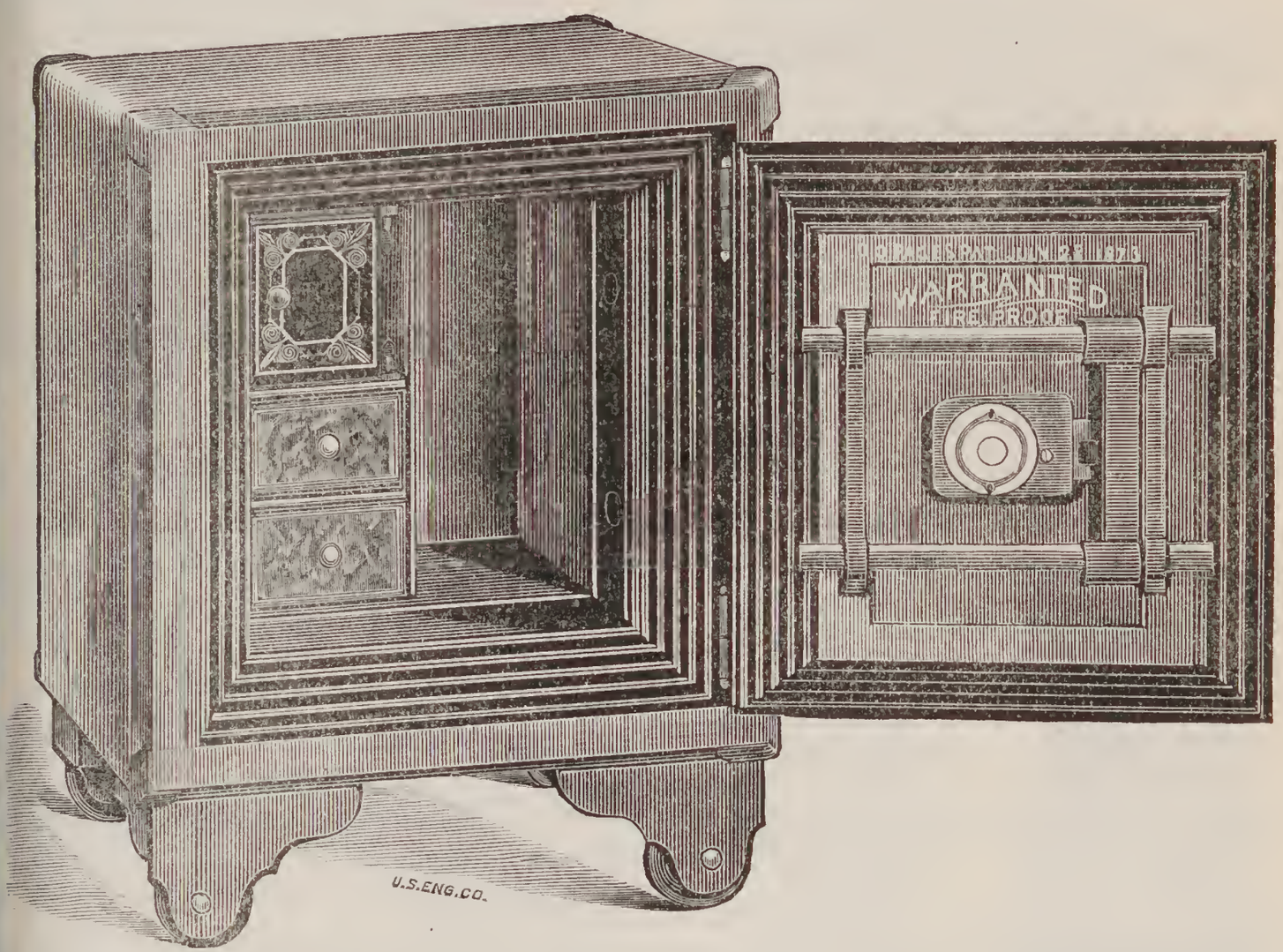

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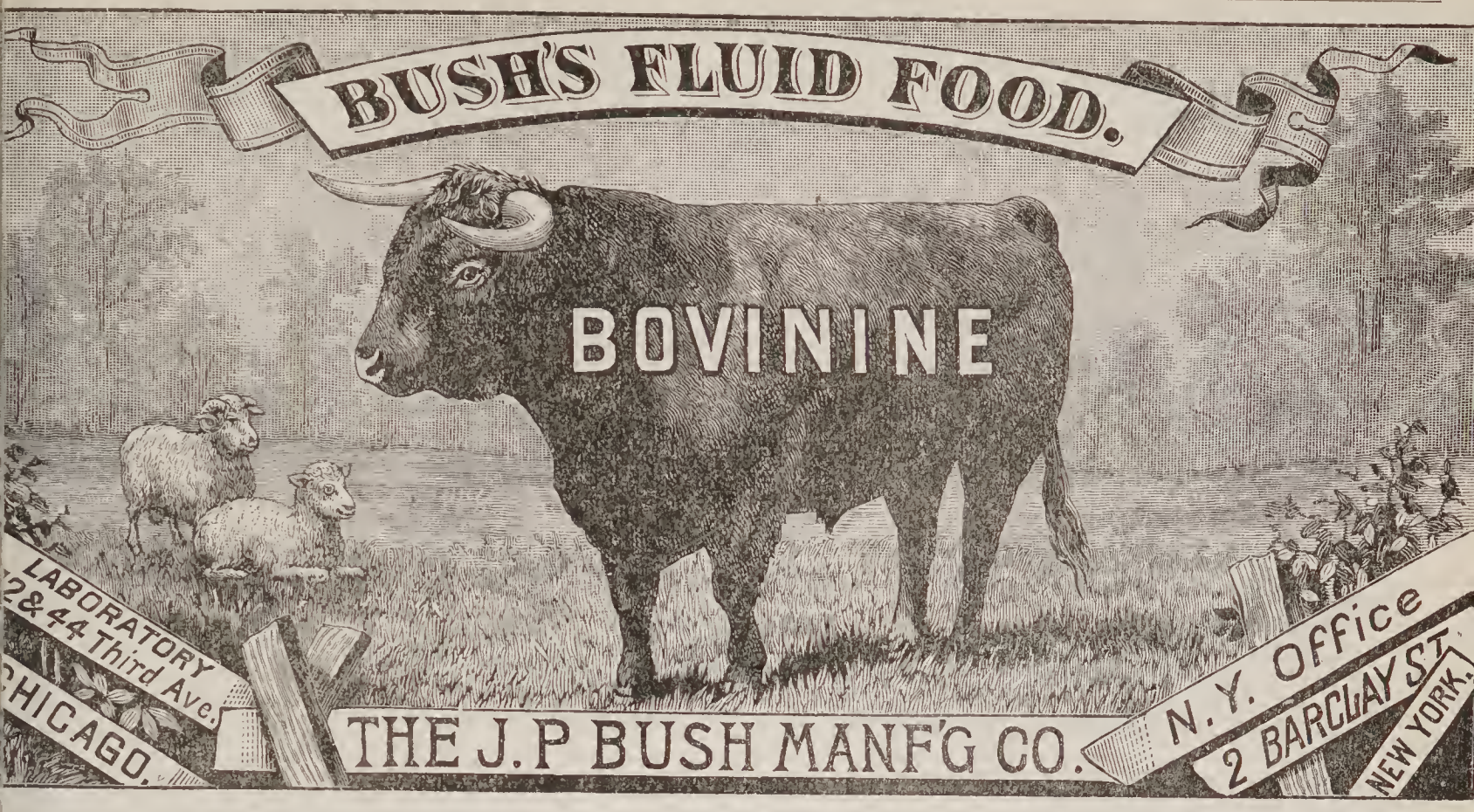

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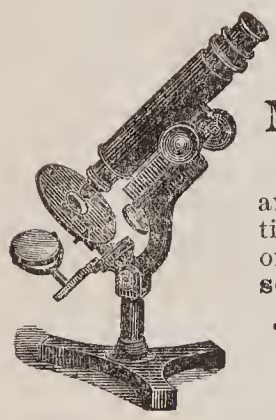

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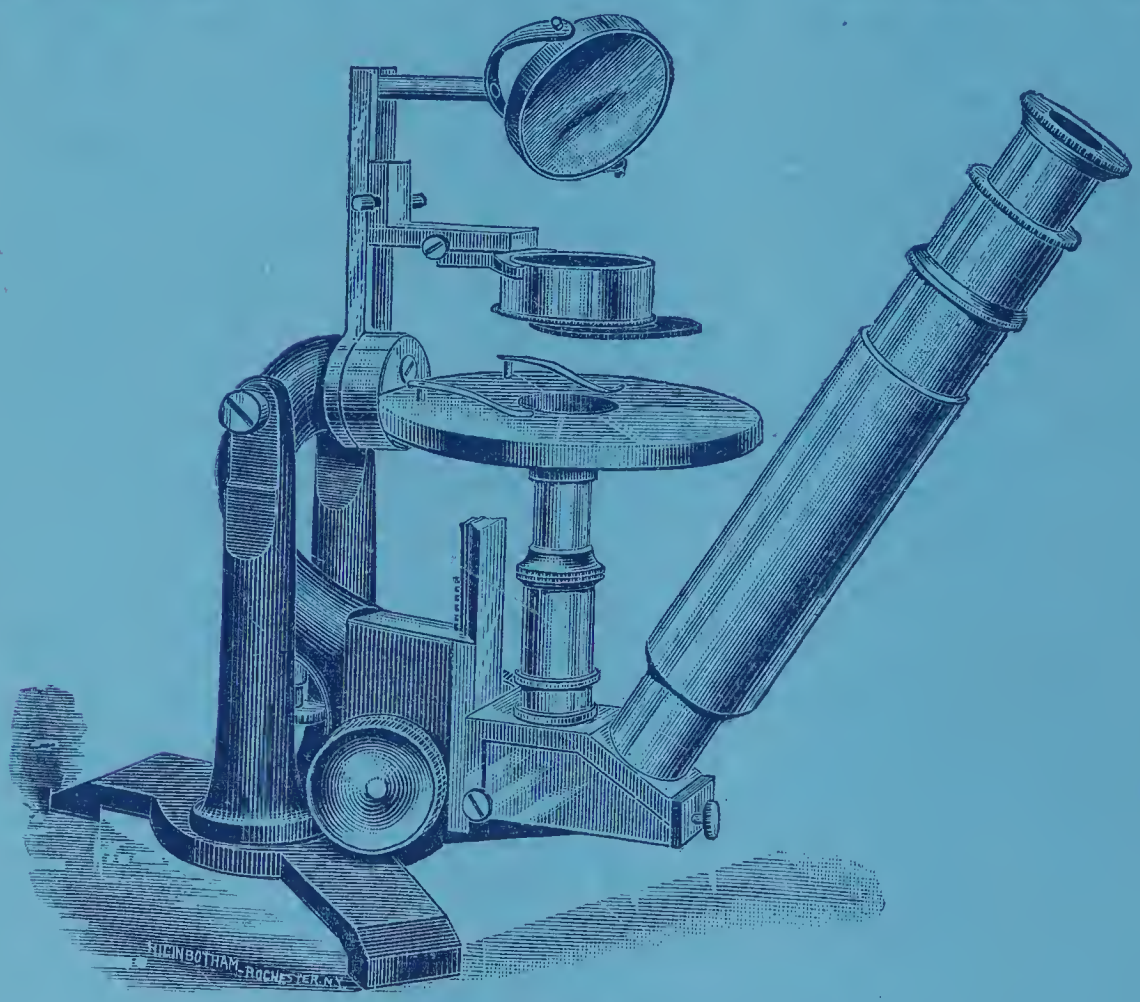

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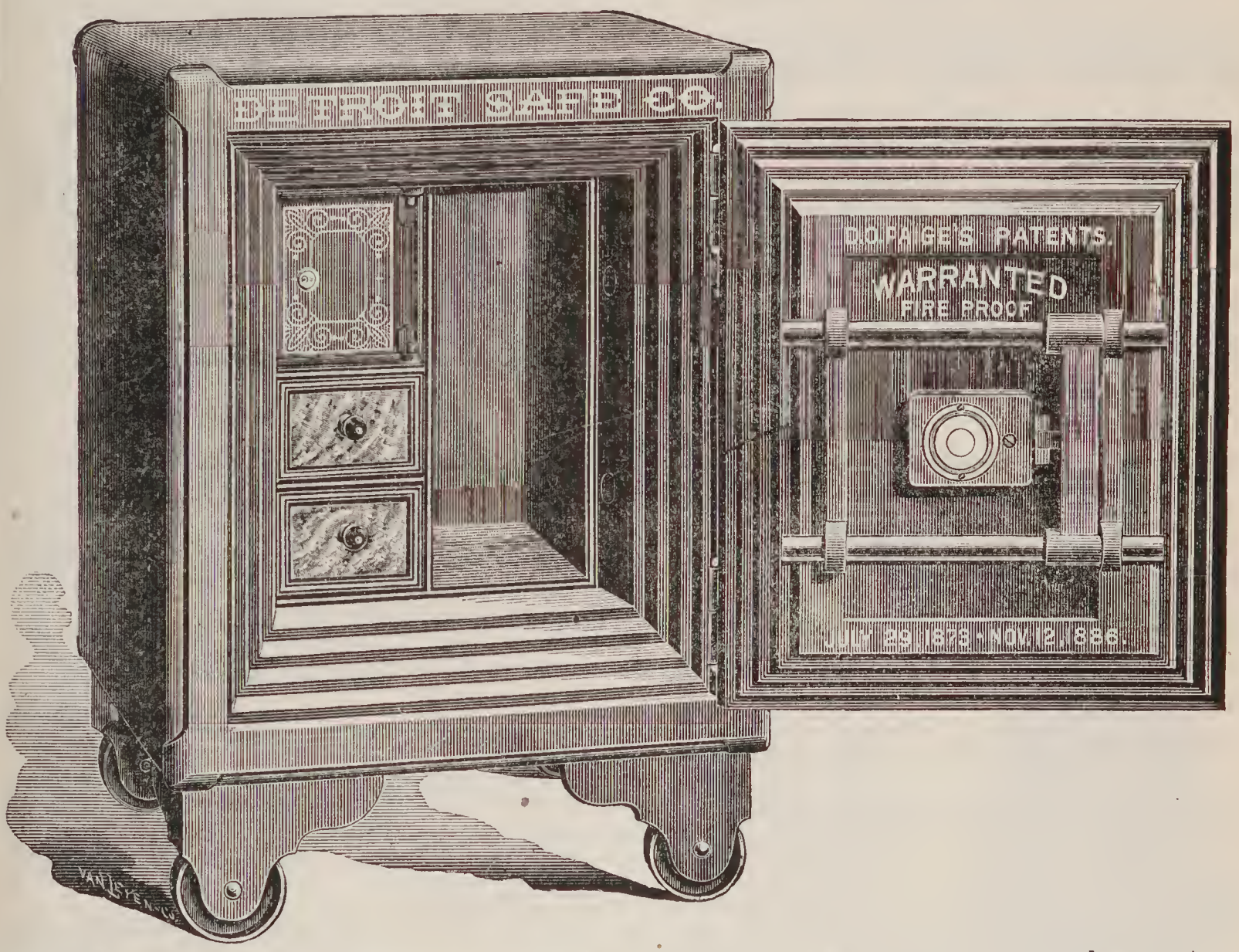

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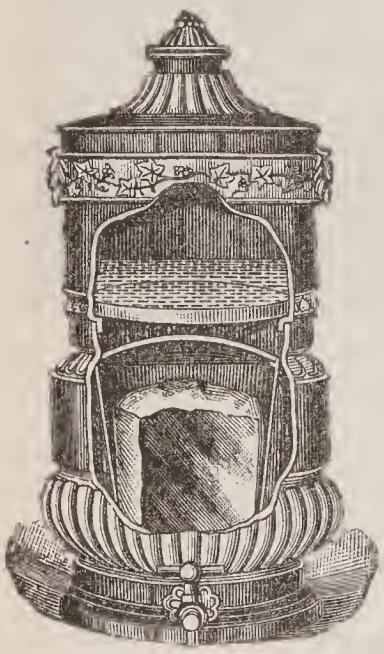

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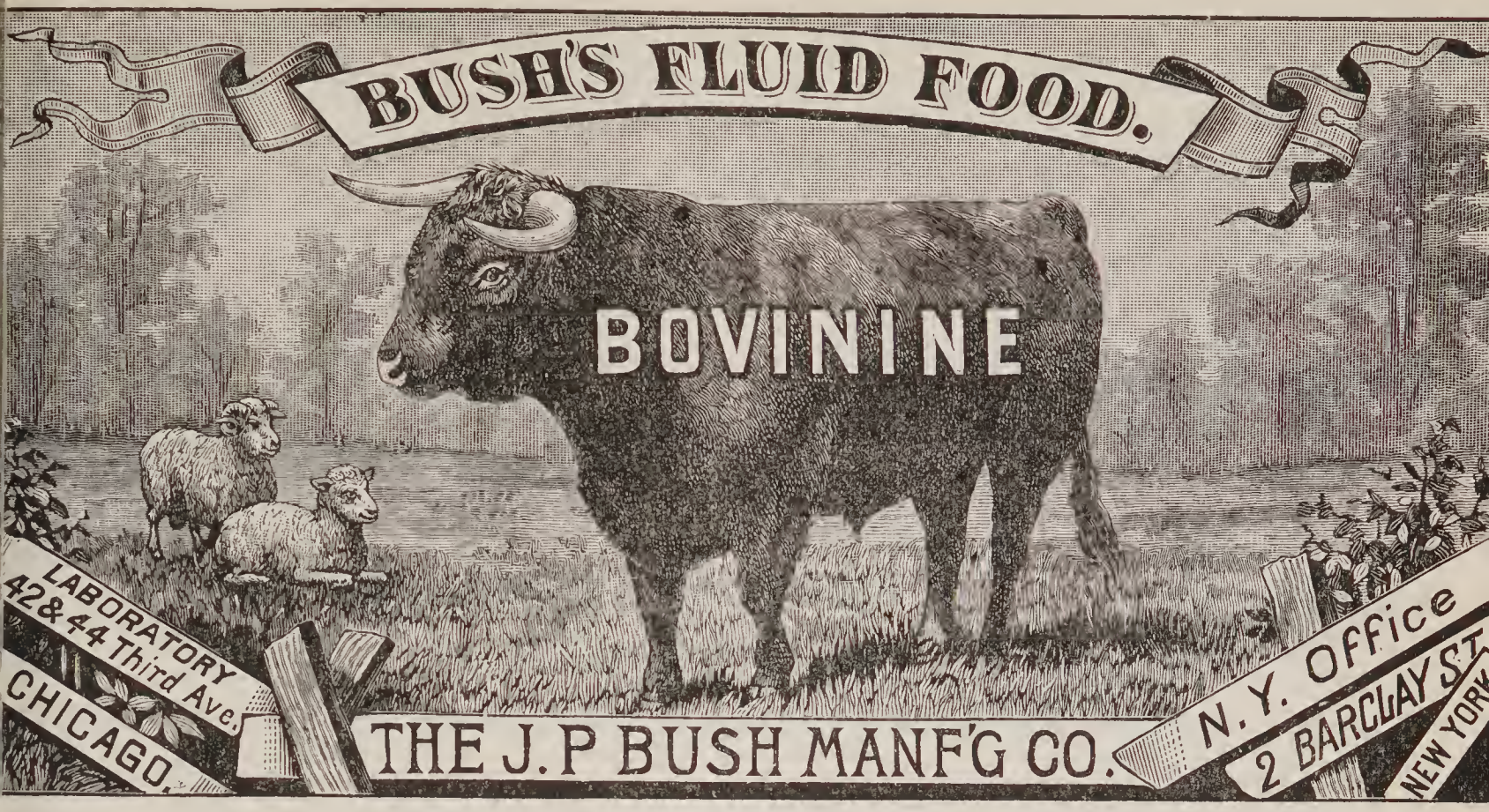

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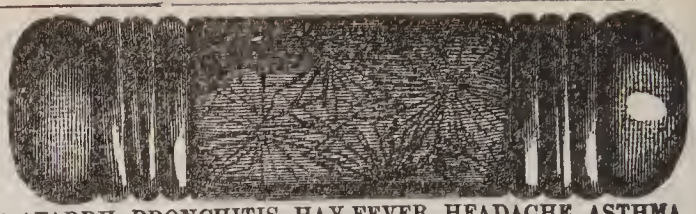

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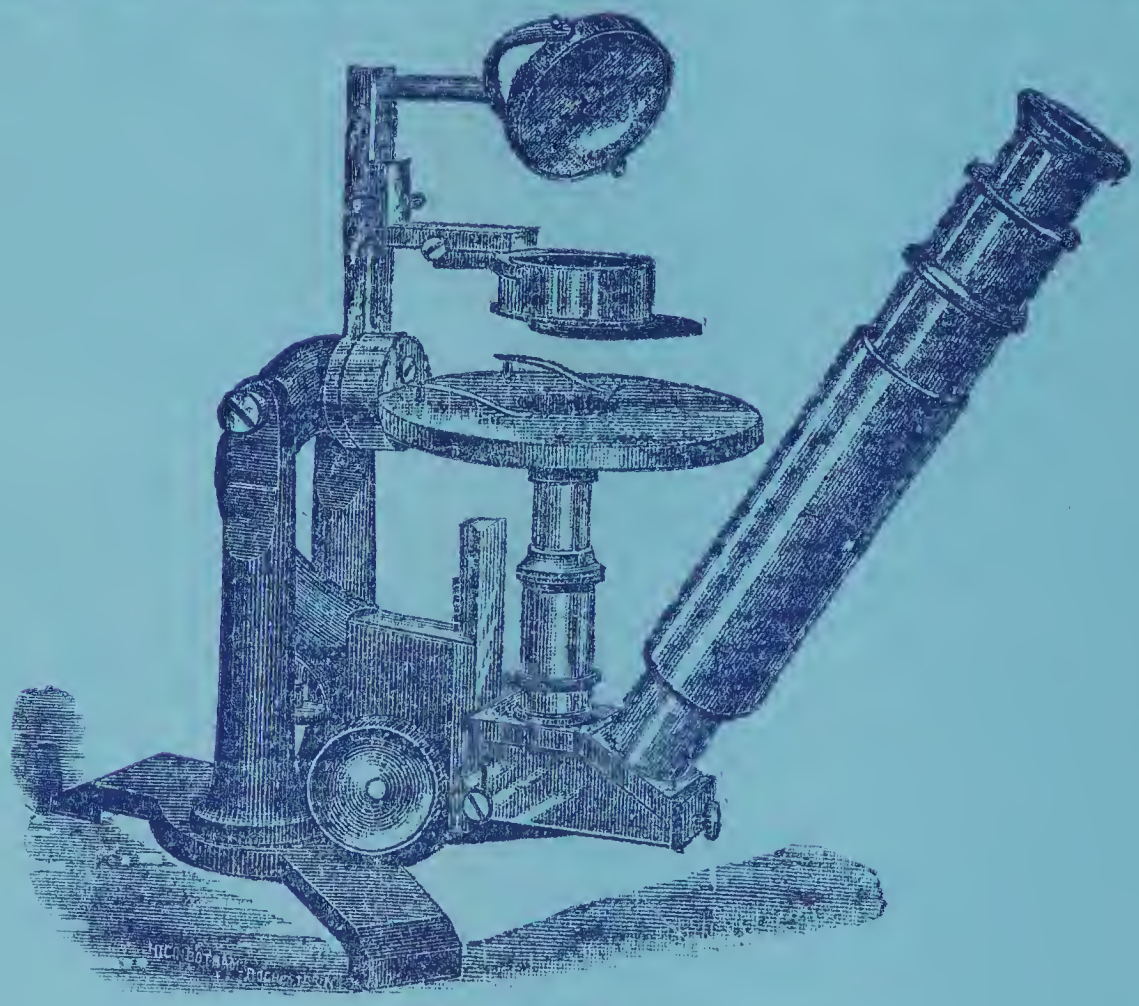

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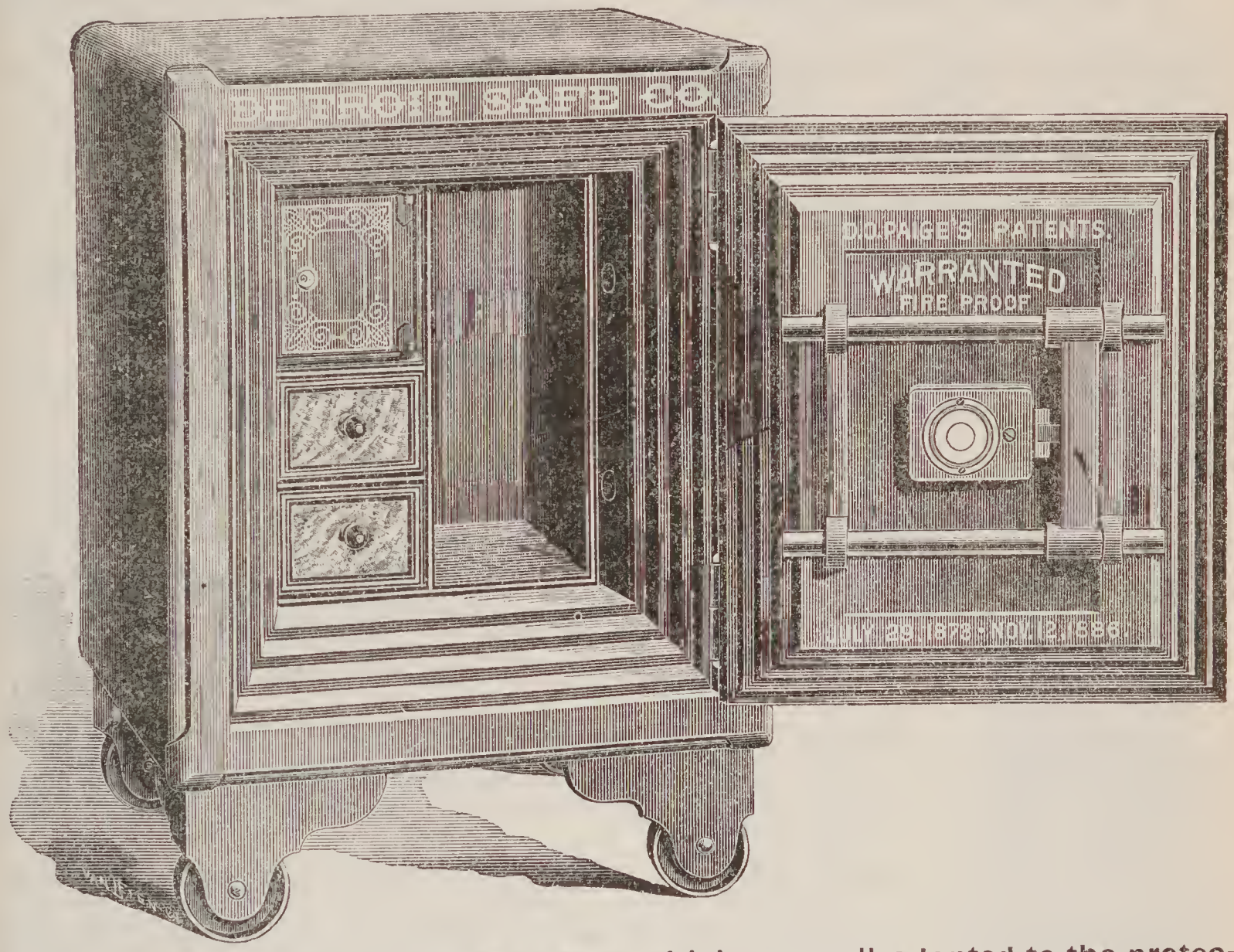

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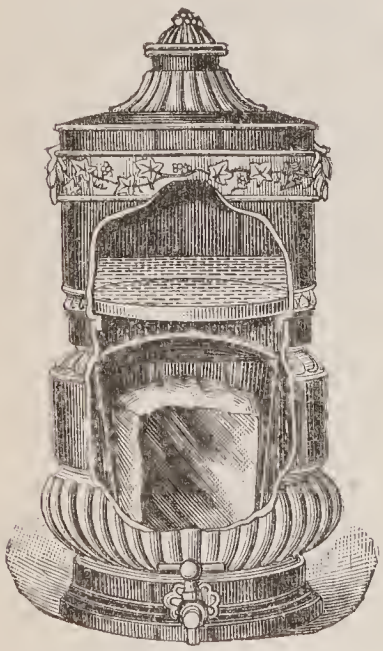

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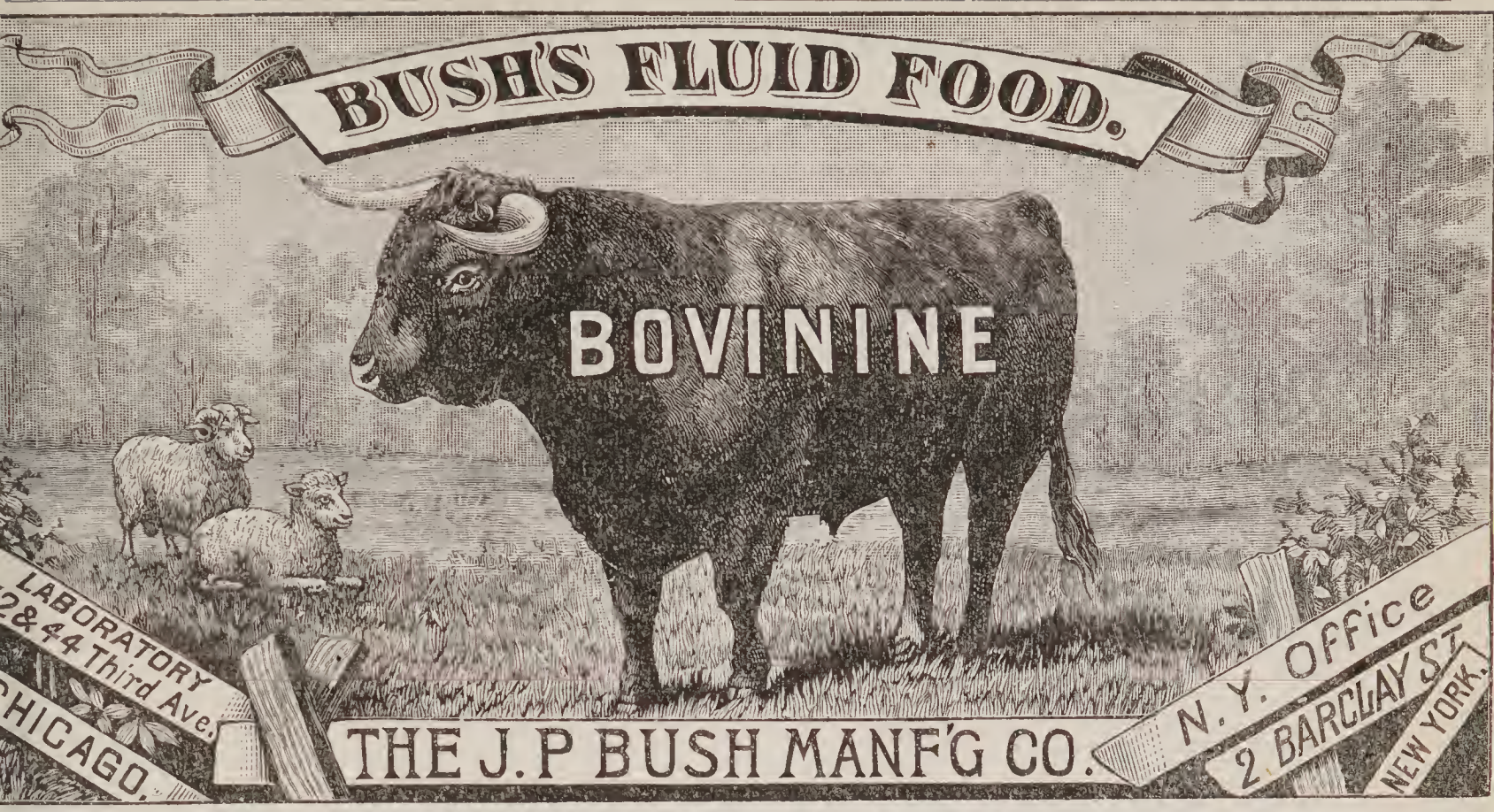

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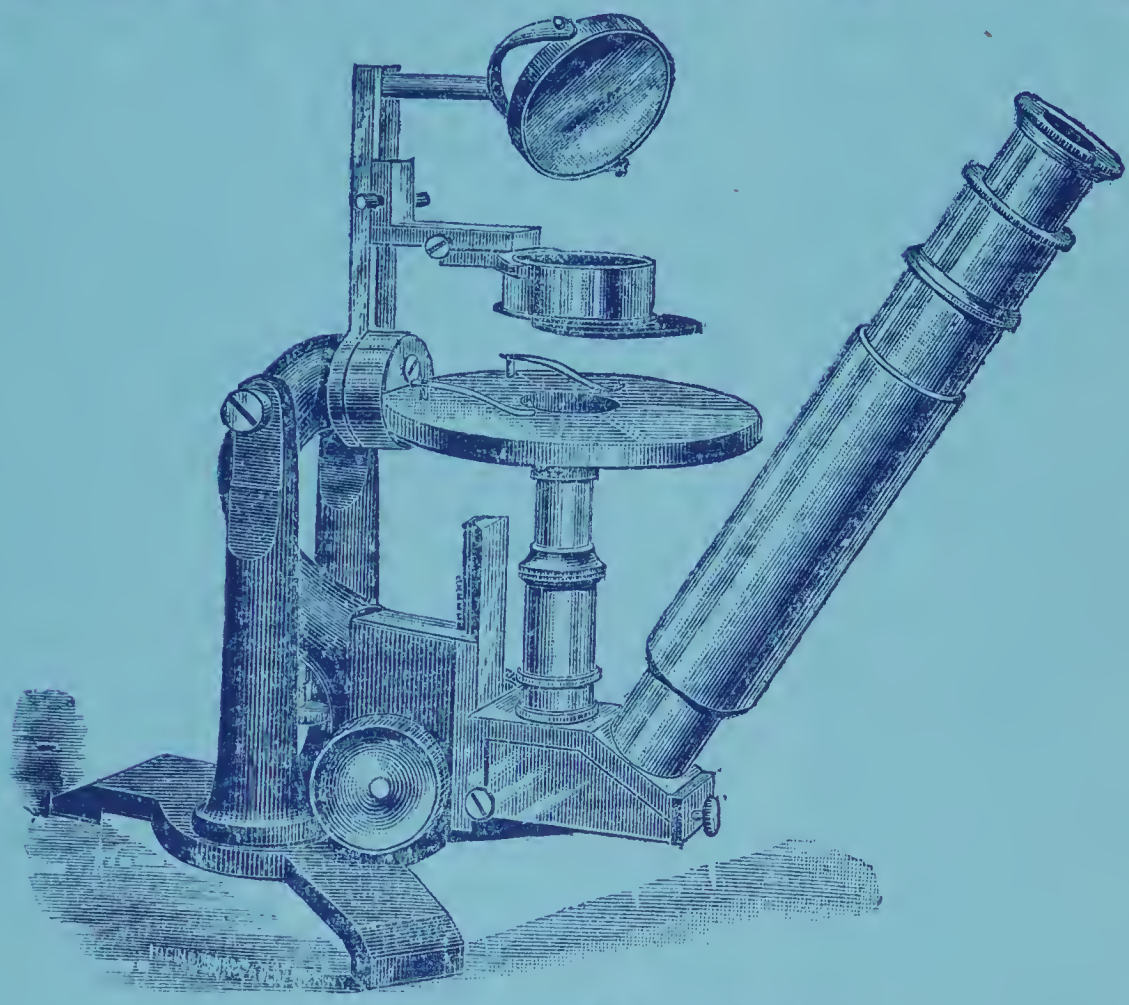

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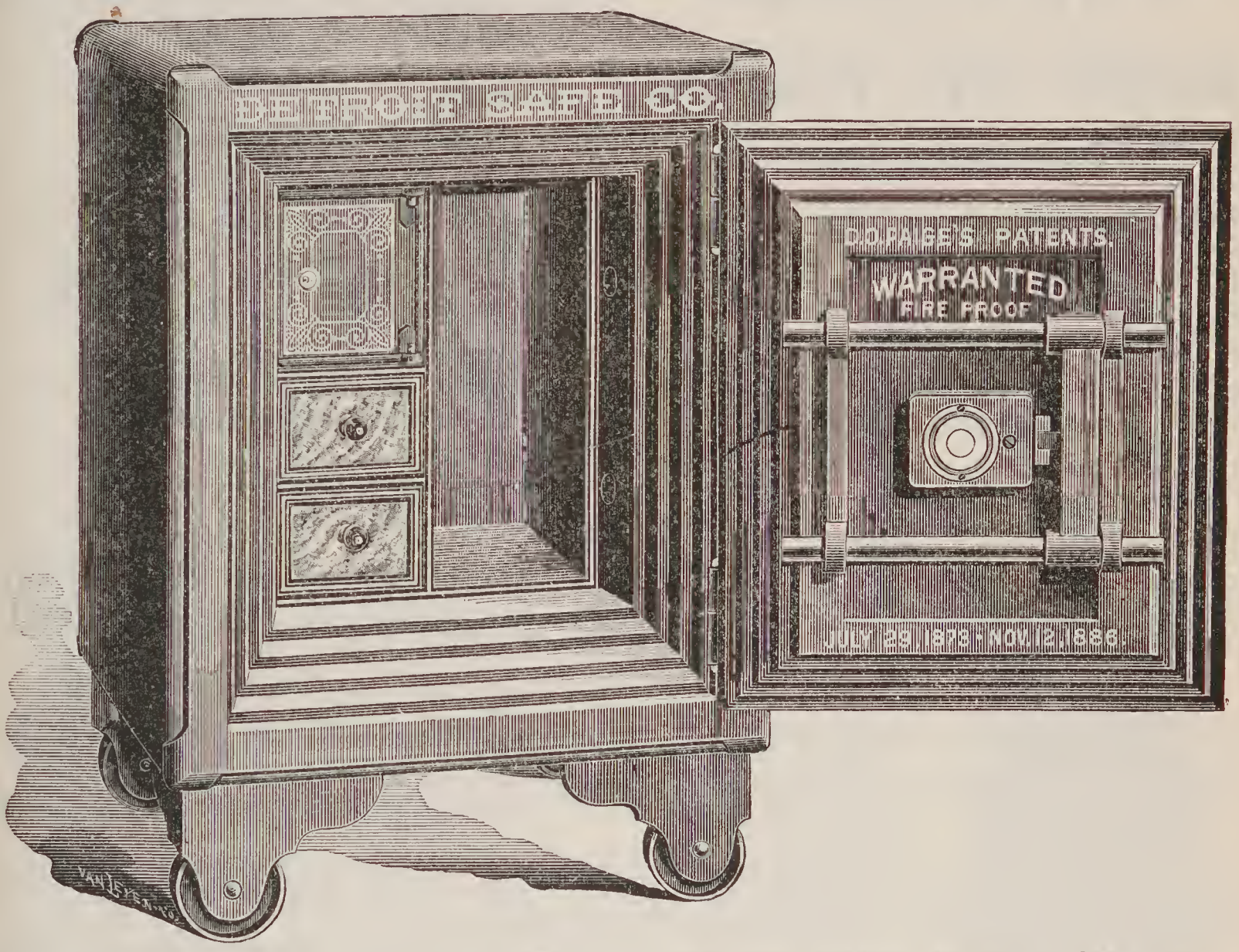

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Newspapers for 1888. From the edition of Geo. P. Rowell & Co.'s "American Newspaper Directory," published April 2d (its twentieth year), it appears that the Newspapers and Periodicals of all kinds issued in the United States and Canada, now number 16,310, showing a gain of 890 during the last 12 months and of 7,136 in 10 years. The publishers of the Directory assert that the impression that when the proprietor of a newspaper undertakes to state what has been his exact circulation he does not generally tell the truth is an erroneous one; and they conspicuously offer a reward of $100 for every instance in their book for this year, where it can be shown that the detailed report received from a publisher was untrue.

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BOOK CHAT.

W. H. C., New York.—A catalogue of North American plants has been published by Dr. J. H. Oyster, of Paola, Kansas. We believe the price is about $1.50.

Dr. B.—Carpenter wrote a paper for the *Quarterly Journal* of the Geological Society in 1849, on "The Microscopical Structure of Nummulina, Orbitolites, and Orbitoides." We have not seen the paper, and only know it by its title.

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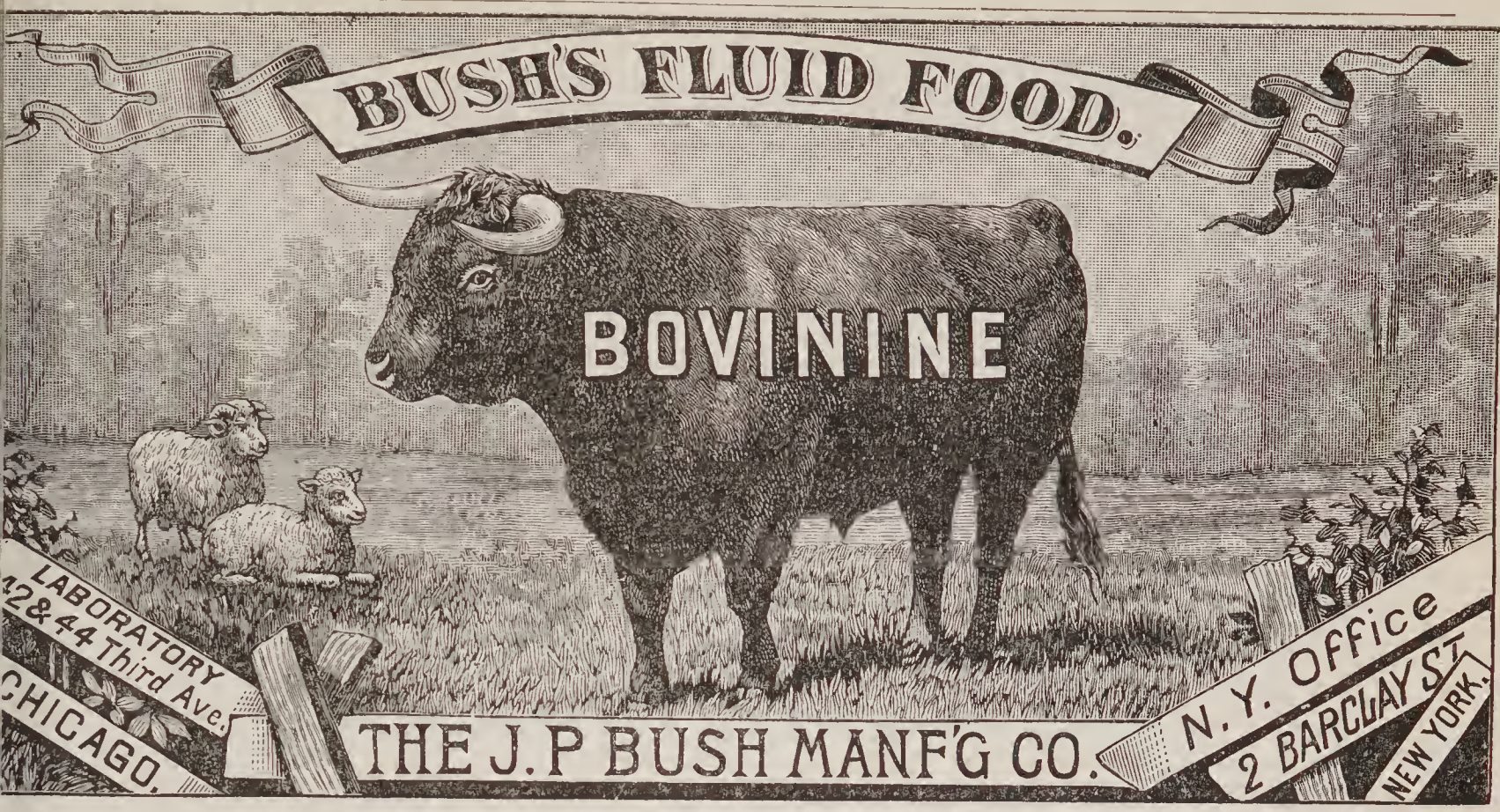

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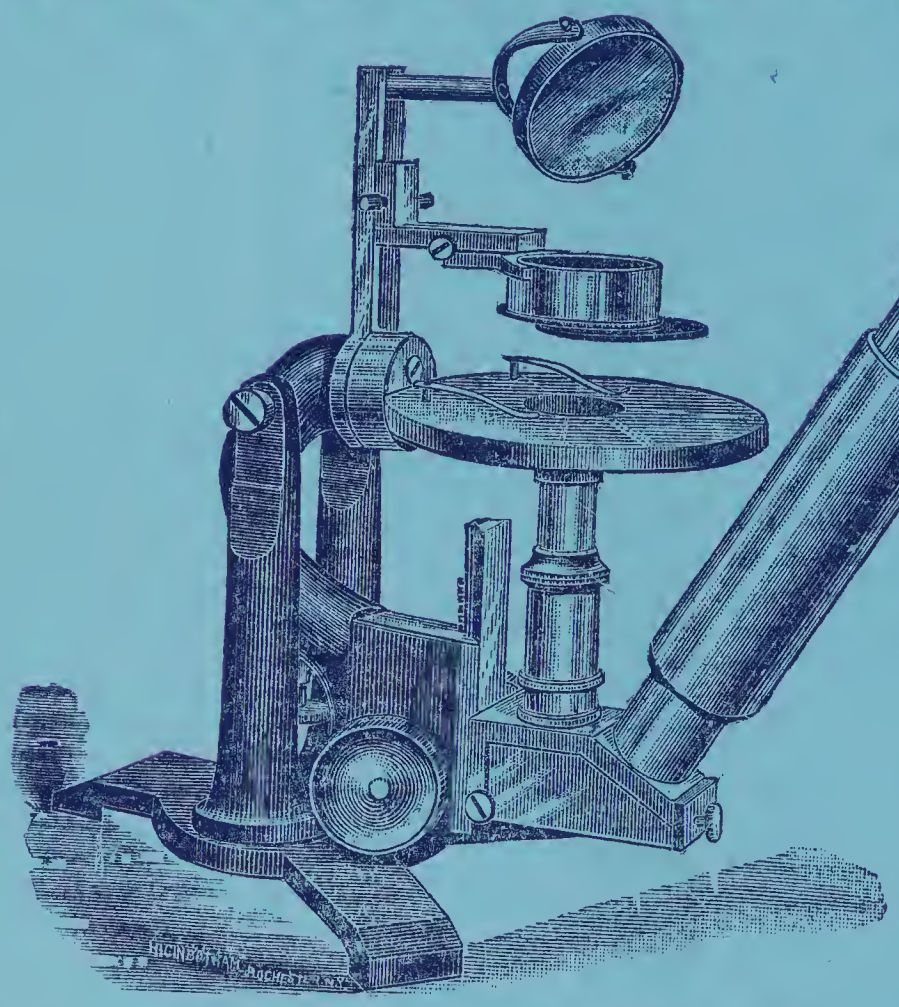

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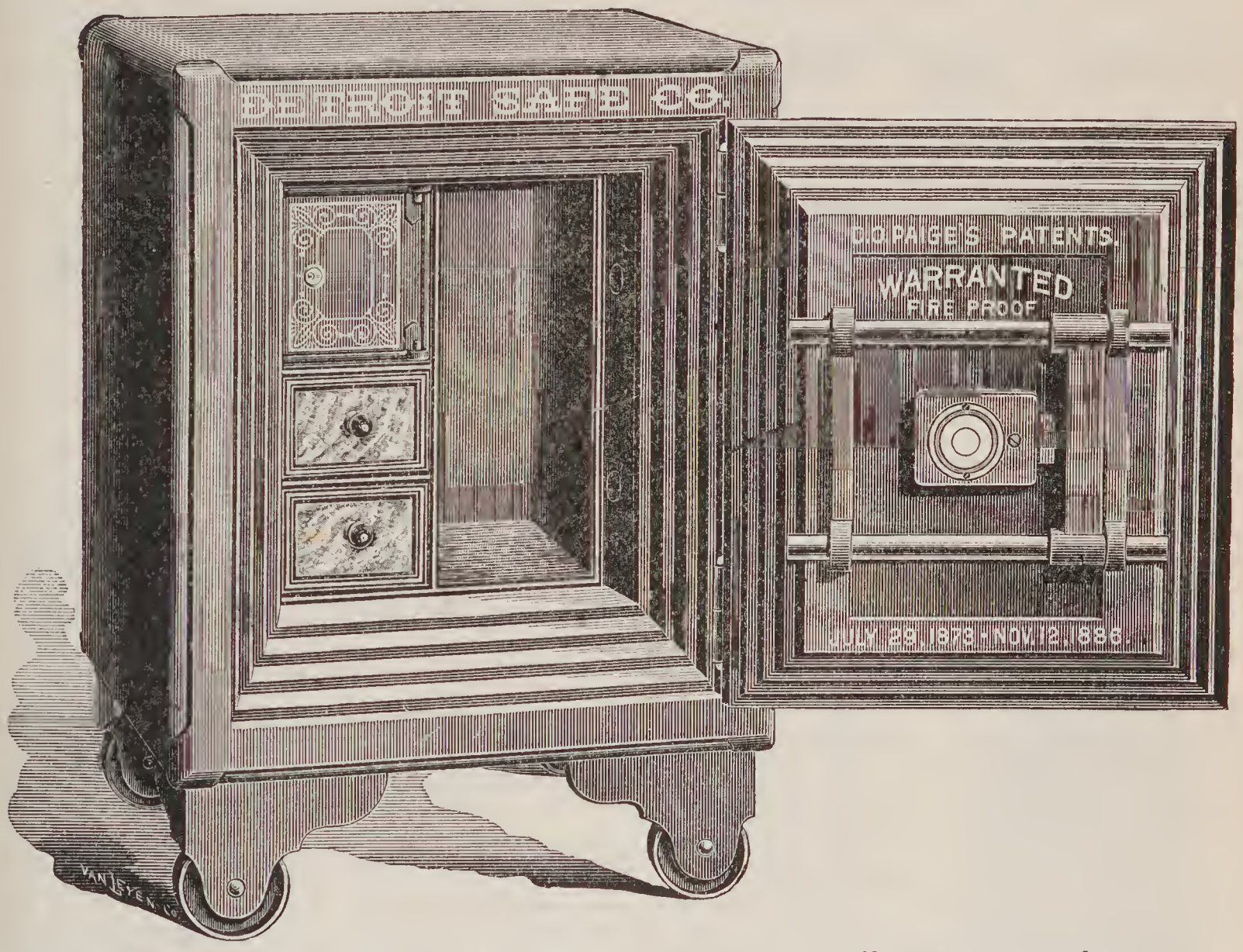

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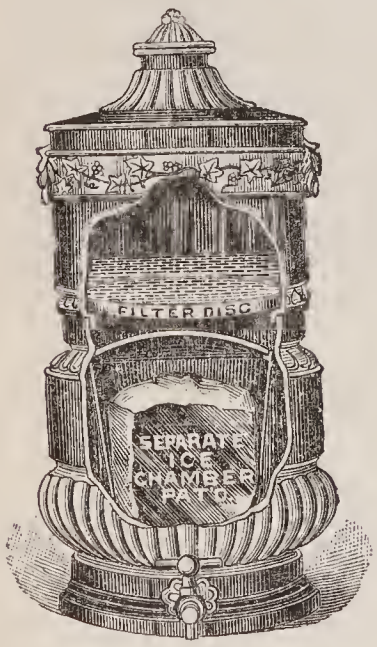

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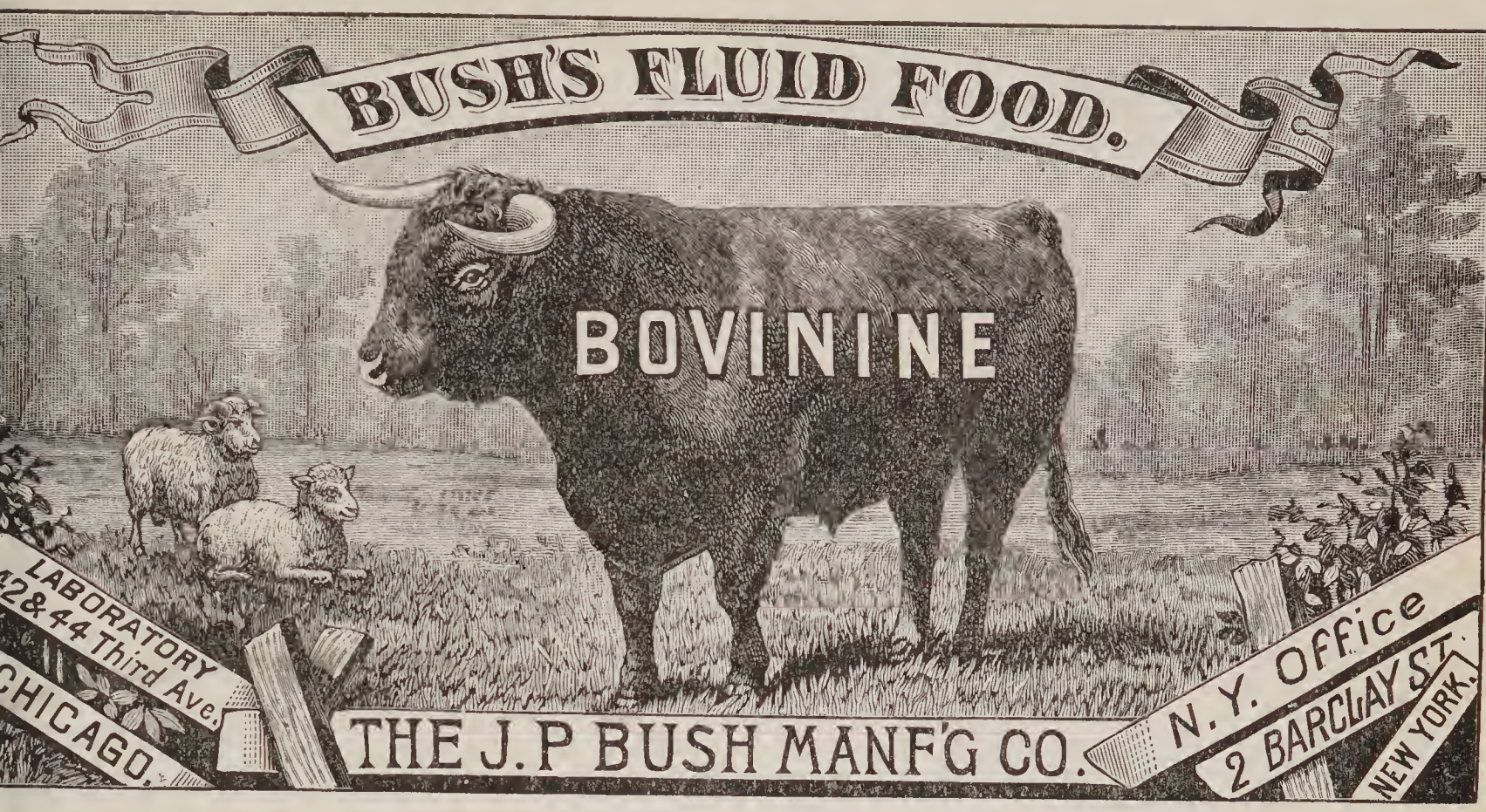

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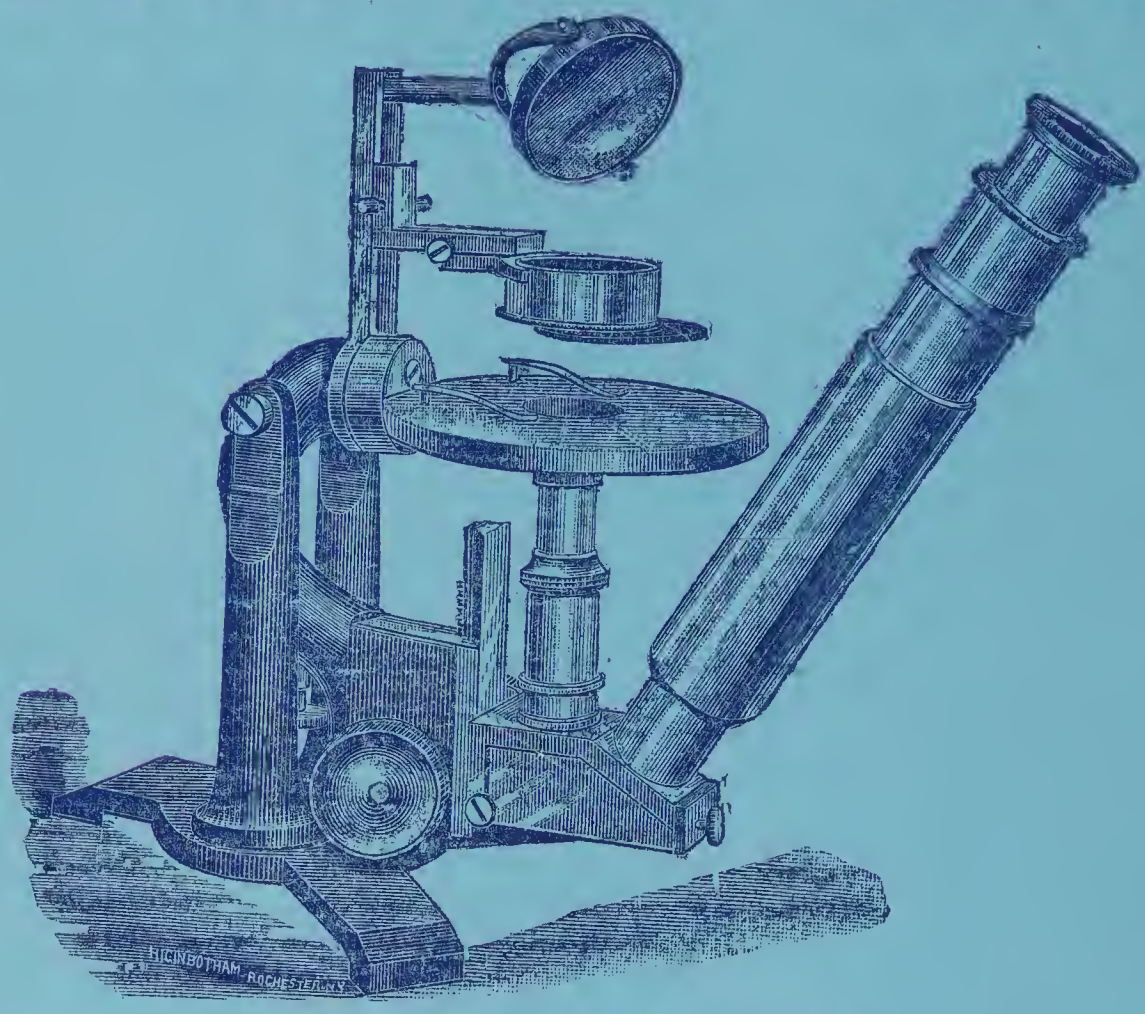

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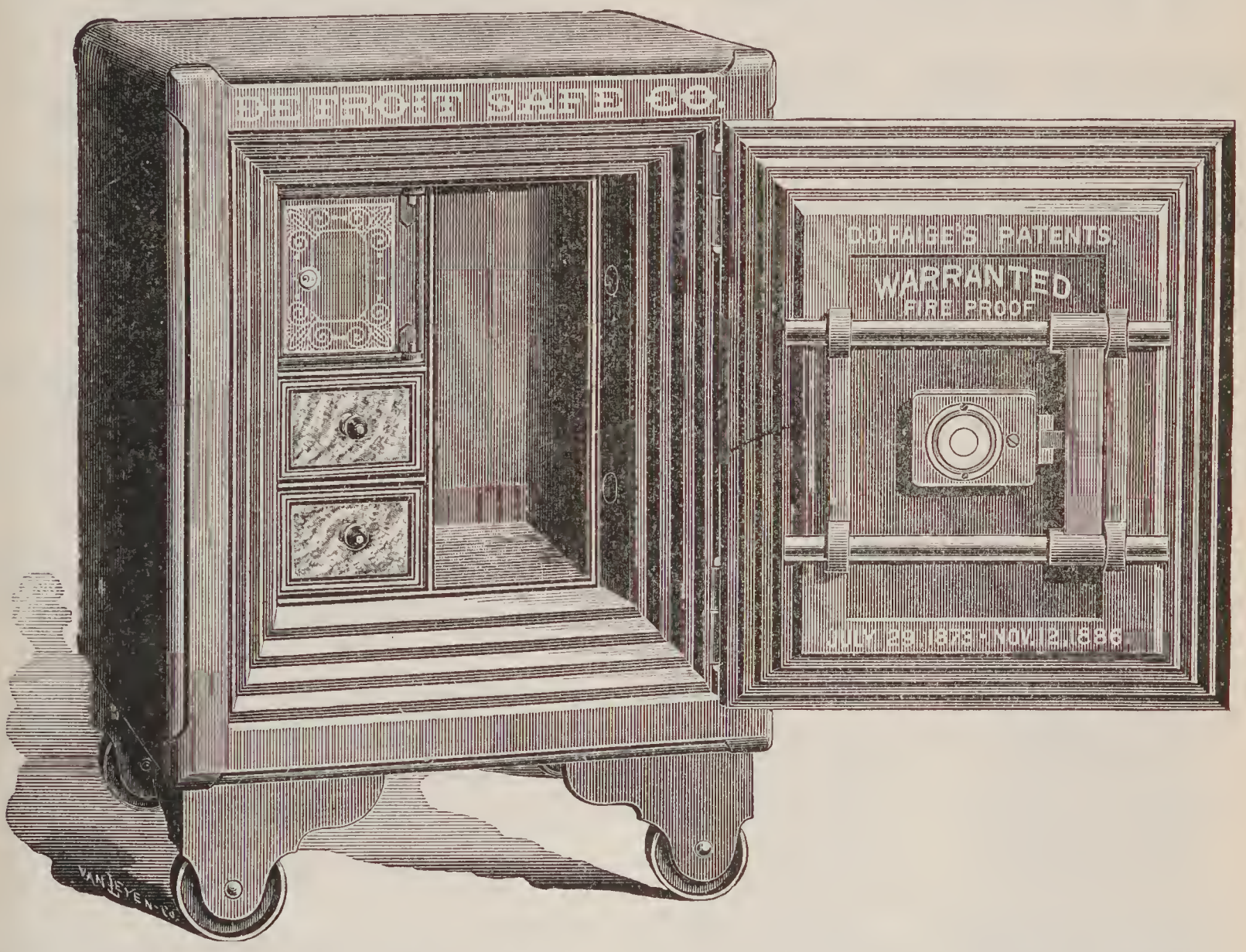

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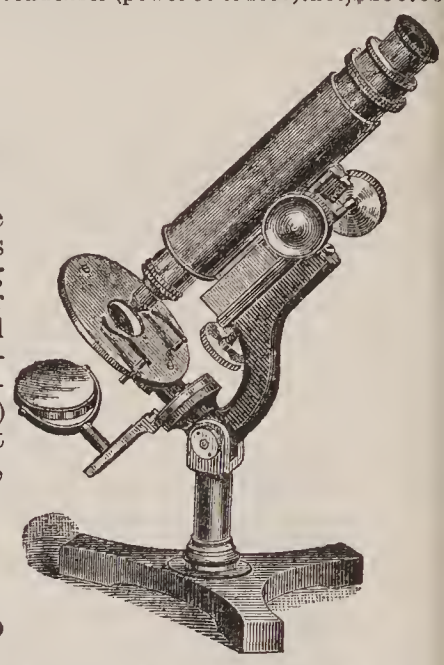

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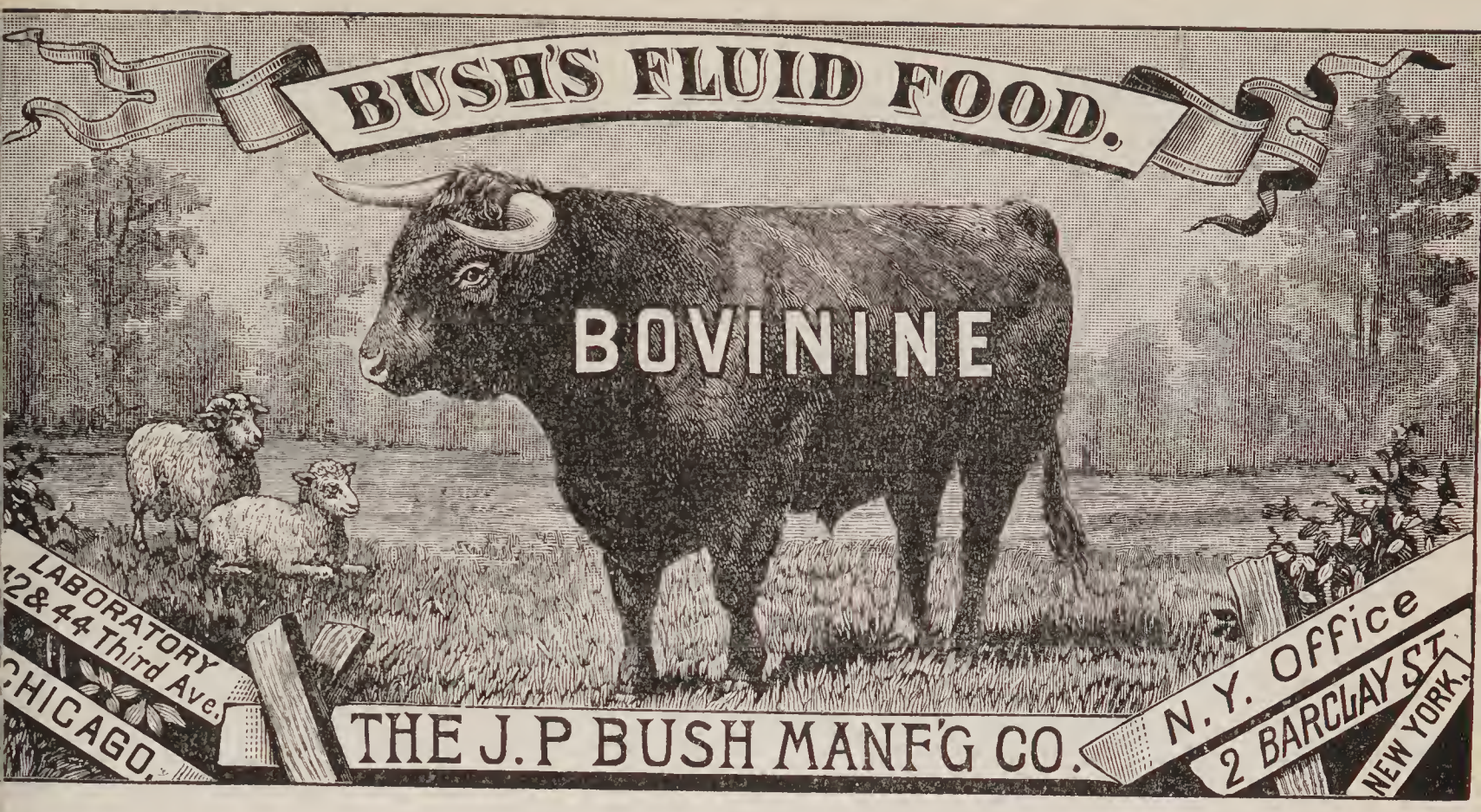

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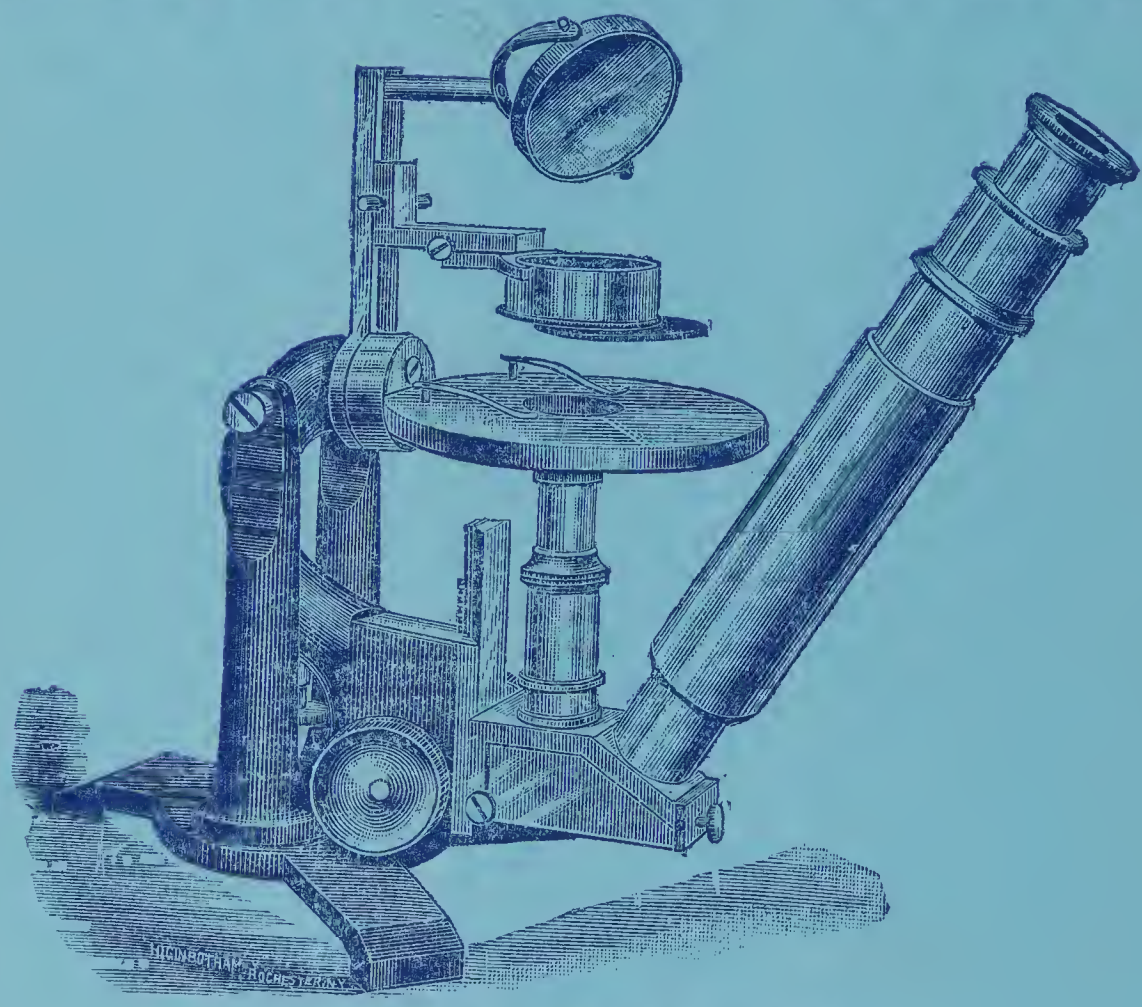

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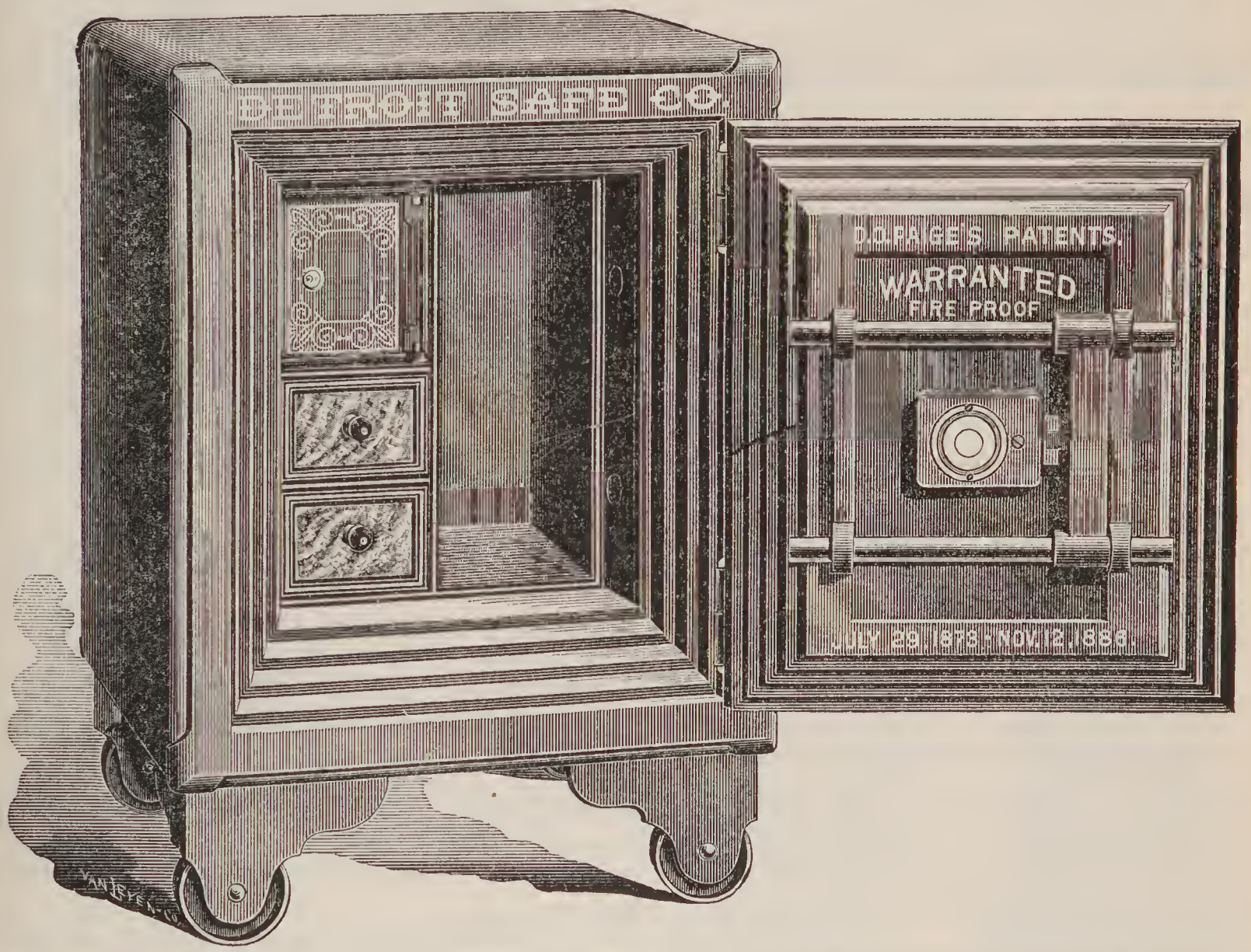

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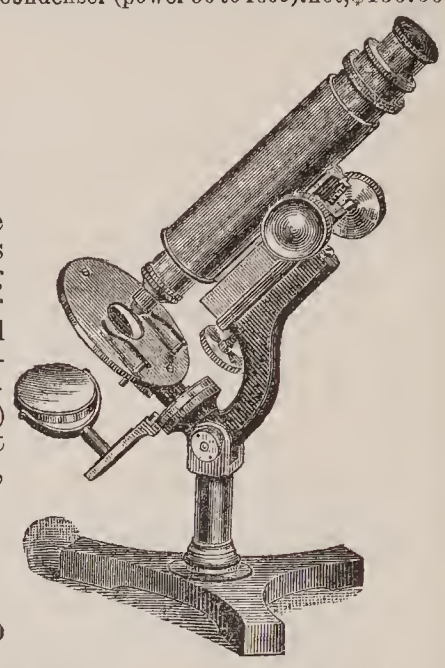

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PUBLISHERS' DEPARTMENT.

Plate VI, which should have been sent out in our June number, was not delivered to us in time, although we held the edition for a week after date of publication. The plate, however, will be found to be well worth the long delay.

Subscribers who have not already done so will confer a favor by sending their subscriptions in without further delay.

N. B.—Too late for insertion in the body of the Journal.—We are informed by Prof. Burrell that the annual meeting of the A. S. M. has been postponed from Aug. 15th to Aug. 21st.

We are happy to announce that the MSS. of Mrs. S. P. Gage's valuable paper on the minute endings of the muscles of the lower animals, a portion of which was read at the Pittsburgh A. S. M. meetings, is now in our hands. Mrs. Gage has continued her researches during the past year, and greatly enlarged the scope of her original paper, which will now be marked as one of the leading contributions to science for the present year. This valuable communication will be illustrated by five full-page plates, and will appear in two installments; Part I, furnishing the leading article for August.

To Subscribers.—We are continually receiving letters from subscribers complaining that they did not receive a slide premium last year and asking for "back pay." We regret that anyone who desired a slide did not receive it, but it was not our fault, as the slide was not asked for. All who asked received, for there were plenty of them. At this date, however, we cannot undertake to supply *last year's* premiums. We also beg to state that our lots are now broken, and the selection not as good as two months ago. We have some very fine slides left, however.

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BOOK BULLETIN.

The Essentials of Medical Chemistry and Urinalysis. By Sam. E. Woody, A. M., M. D., Professor of Chemistry and Public Hygiene, and Clinical Lecturer on Diseases of Children, in the Kentucky School of Medicine. Second edition. Price, $1.50.

The Infectious Diseases, Vol. I. By Karl Liebermeister. Pp. 141. Paper, 25c.; Cloth, 50c.

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BOOK CHAT.

Dr. B., San Antonio, Texas.—We have sent you Haddon's Practical Embryology by post. Thanks for your kind words in regard to our book department. We are not booksellers, but we are always glad to serve our subscribers to the extent of our ability.

M., New York.—The subject is too extensive to be answered in these columns. Consult the bibliograpy in some work devoted to this discussion. Perhaps you might get some ideas from Bastin's "On the conditions favoring fermentation and the appearance of Bacilli, Micrococci and Torulae, in previously boiled Fluids."

Dr. W., Boston.—J. S. Bowerbank has written a good deal on sponges, and the work of H. J. Carter is well known. In this country Potts and our friend and contributor, Mr. Henry Mills, have done much original investigation Spongiadæ. We publish articles on this subject as often as possible. Why may we not hear from you?

D., Battle Creek, Mich.—We shall publish at an early date another article on Diatoms, by Mr. K. M. Cunningham. Mr. Christian writes us that he also has an article under way for us. The diatomists are either preparing some elaborate work, or have given up microscopy; we hear little from them nowadays. Suppose you give us some notes.

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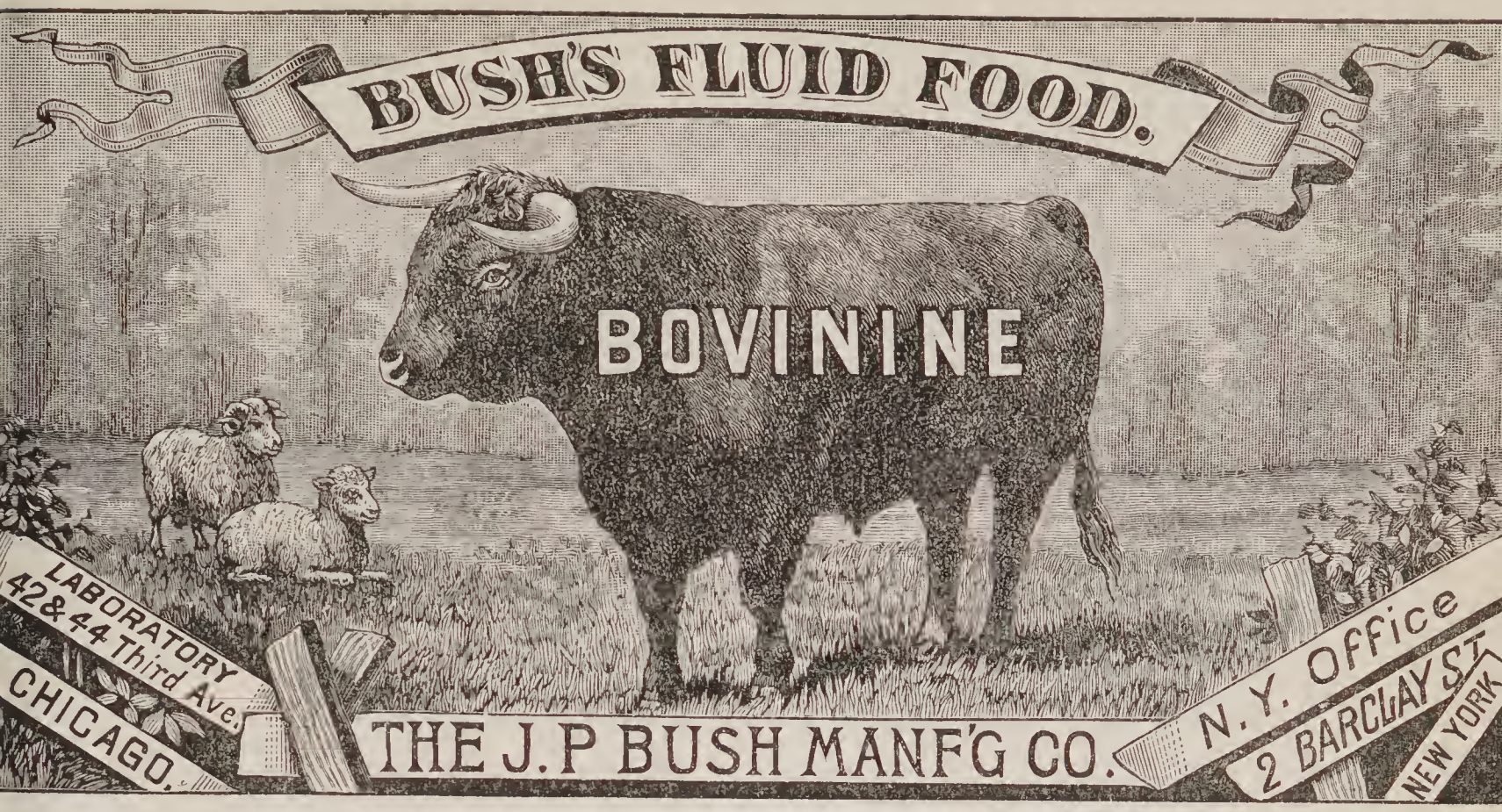

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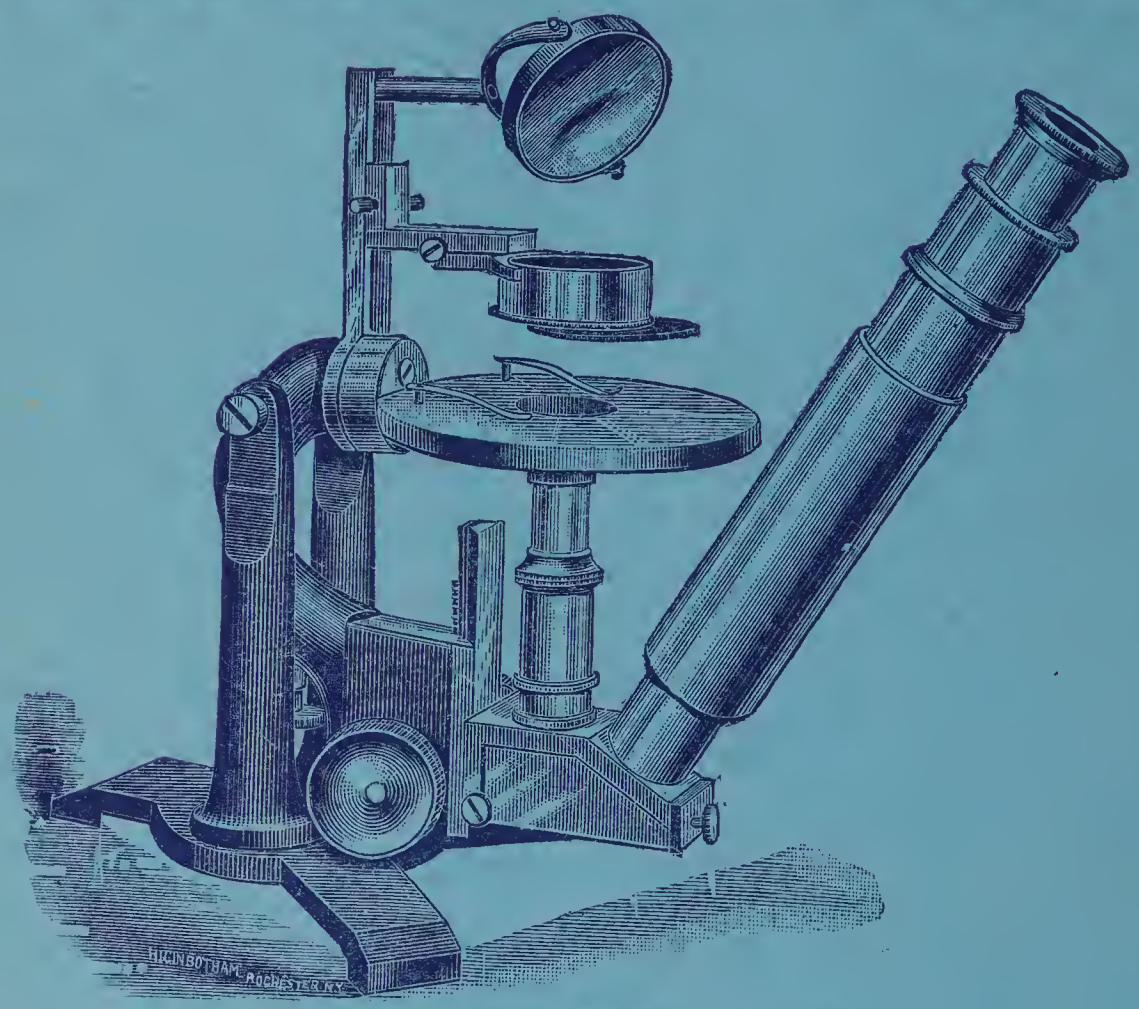

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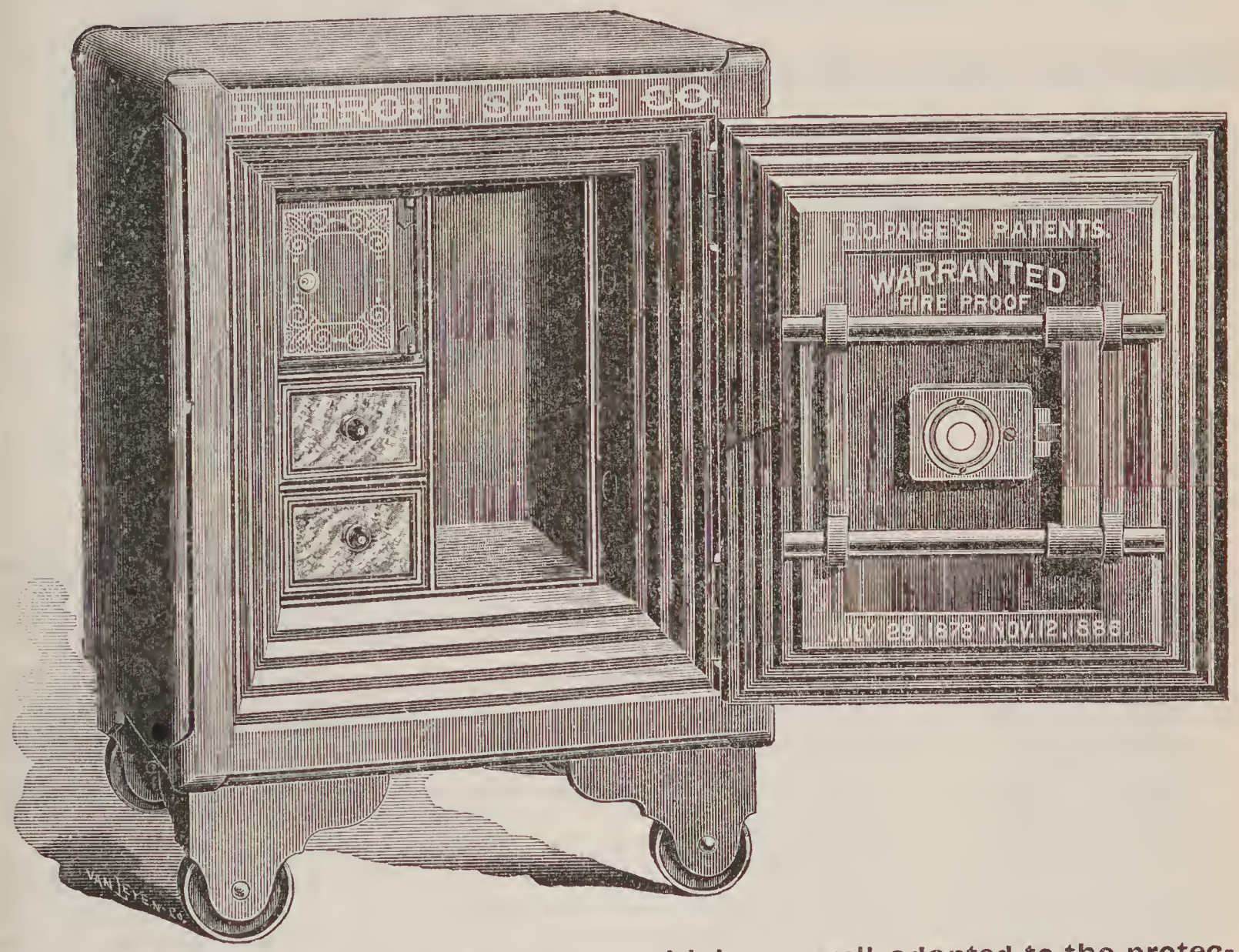

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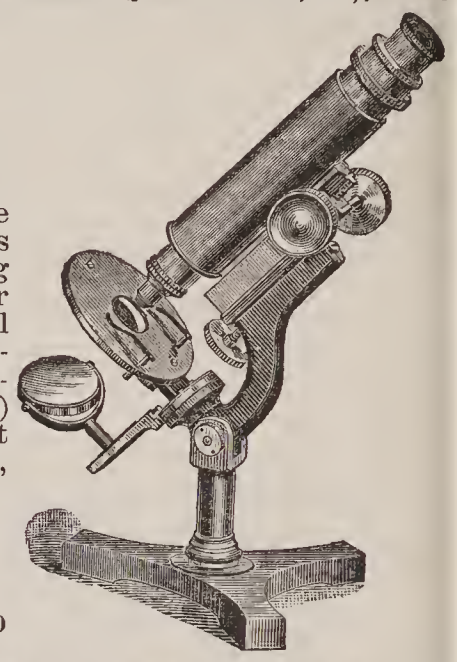

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ELEVENTH ANNUAL MEETING.

THE arrangements for the Eleventh Annual Meeting of the Society having been completed, this circular of information is issued for the guidance of members and others who anticipate attendance.

Arrangements have been made at the Park Hotel for the accommodation of all attending the meeting, at $2.00 per day. This hotel is two blocks north of the Union depot and upon the corner of High and Goodale Streets, easily reached by walking and by street cars. The meetings will be held in Wirthwein's Hall opposite the opera house on South High Street, also readily reached from the depot by walking or by the street cars. In connection with this hall there are several smaller rooms which are at the disposal of the society, and for the use of dealers in the exhibition of goods. The working session and evening *soiree* will be held at the same place. It is proposed to hold the Wednesday afternoon meeting at the Ohio State University, where special facilities will be provided for lantern illustrations and other important aids in the prosecution of the program. For this meeting transportation will be furnished by the local society, and the ladies will provide a collation upon the grounds.

The committee in charge of the working session earnestly solicit members to take part in this practical feature of the meeting. Those complying with this request will please communicate to the chairman or to any member of the committee their subject, with a statement of what they will require for use. Each member is also invited to bring to the meeting for exhibition new or interesting apparatus, microscopical curiosities of any kind, rare books, instructive specimens, etc. Provision will be made for the proper exhibition and careful preservation of all such objects.

A large number of invited guests will be present at the *soiree*, and in order to make the usual excellent entertainment, each member is urged to bring to the exhibition one or more microscopes with popular but good objects for each, showing and explaining in the best manner. Objects of one's own mounting and study, for low or medium powers, are generally most satisfactory. Please communicate at once to Professor H. A. Weber, Columbus, Ohio, the name of each microscope to be used, the magnifying power, and the name and description of each object to be shown, written as it should be in the printed program. The local committee will furnish all needed tags, labels, lamps, &c.

Those intending to read papers, or to present any theme for discussion or practical demonstration, are earnestly requested to send to the Secretary as soon as practicable, *at once if possible*, their titles and abstracts, that the executive committee may properly arrange the program. Blanks for the purpose may be had at any time of the Secretary. Authors are also urged to have their manuscripts and drawings so completed and revised that they may be left with the committee on publication at the meeting. *Please attend to this.* The last volume is not yet issued, in part because this rule was not heeded last year. It is earnestly hoped no cause of delay will again prevent the prompt appearance of the annual publication.

The Central Traffic Association has granted excursion rates from all points within its territory, viz: from Buffalo and Pittsburgh upon the east, and from Chicago, Peoria and St. Louis upon the west, to Columbus and return, at one and one-third fare, upon the certificate plan. Tickets must be purchased not more than three days prior to the meeting *and a certificate of such purchase obtained of the agent selling same* at the usual fare. Such certificates, signed by the Secretary of the Society at Columbus, and presented within three days after the close of the meeting, will secure a return ticket at one-third single rate. No reduction will be made unless a certificate is procured at starting point from the ticket agent. If through tickets cannot be had at starting point, purchase to the next convenient point, where such through tickets can be had, and there get certificate. Similar arrangements are expected from the eastern trunk lines. T. J. BURRILL, *Secretary.*

Champaign, Ill., August 4th, 1888.

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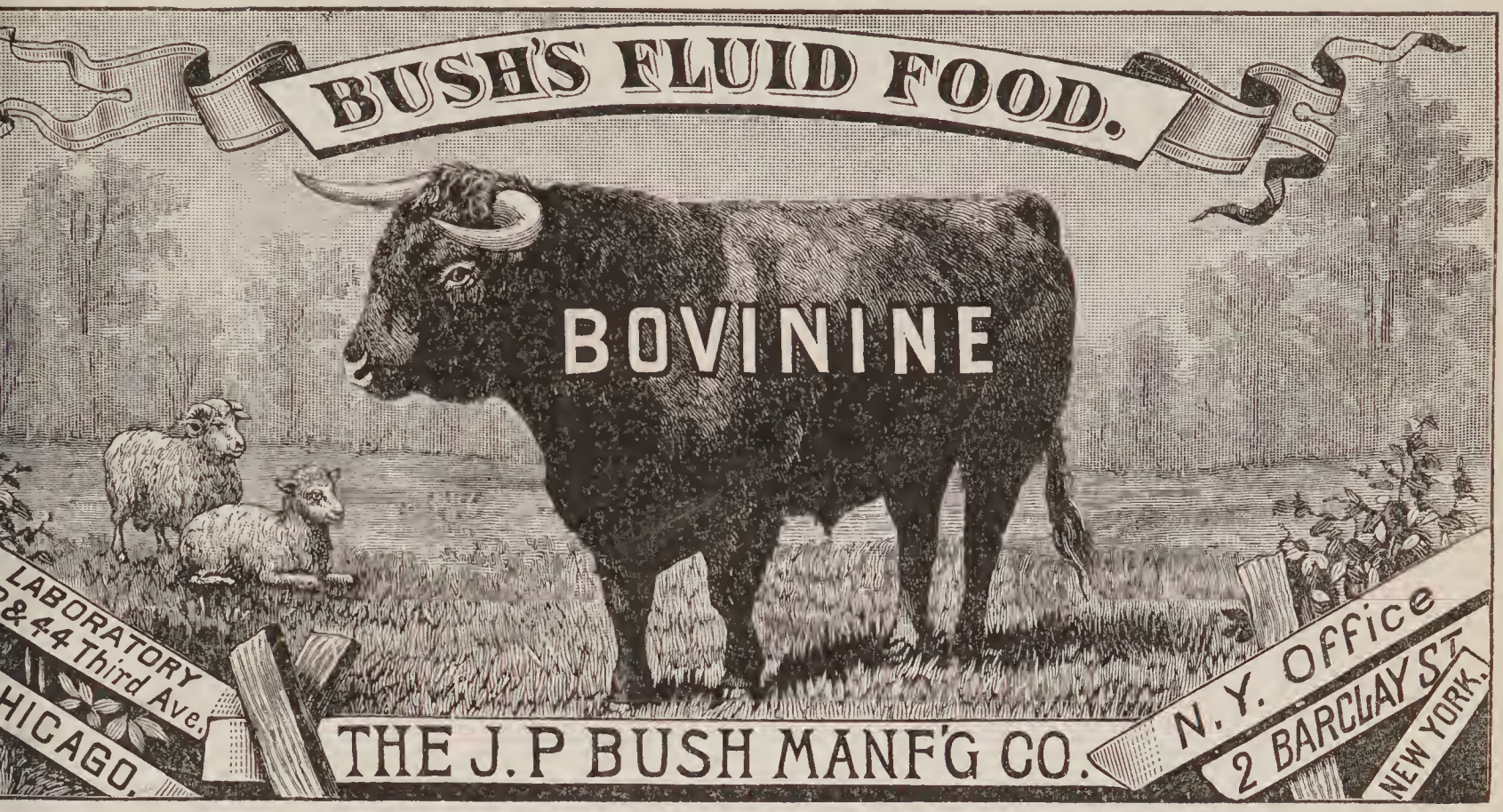

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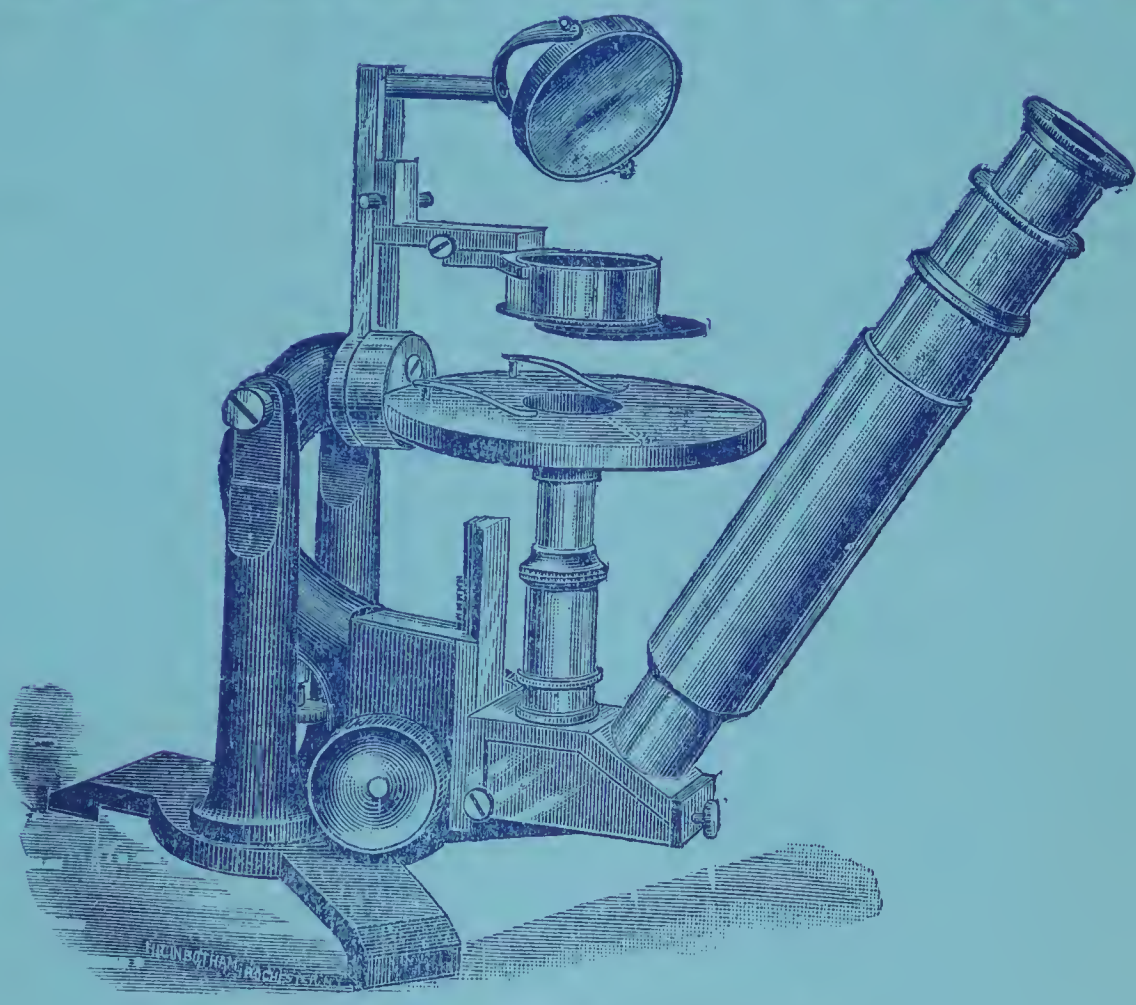

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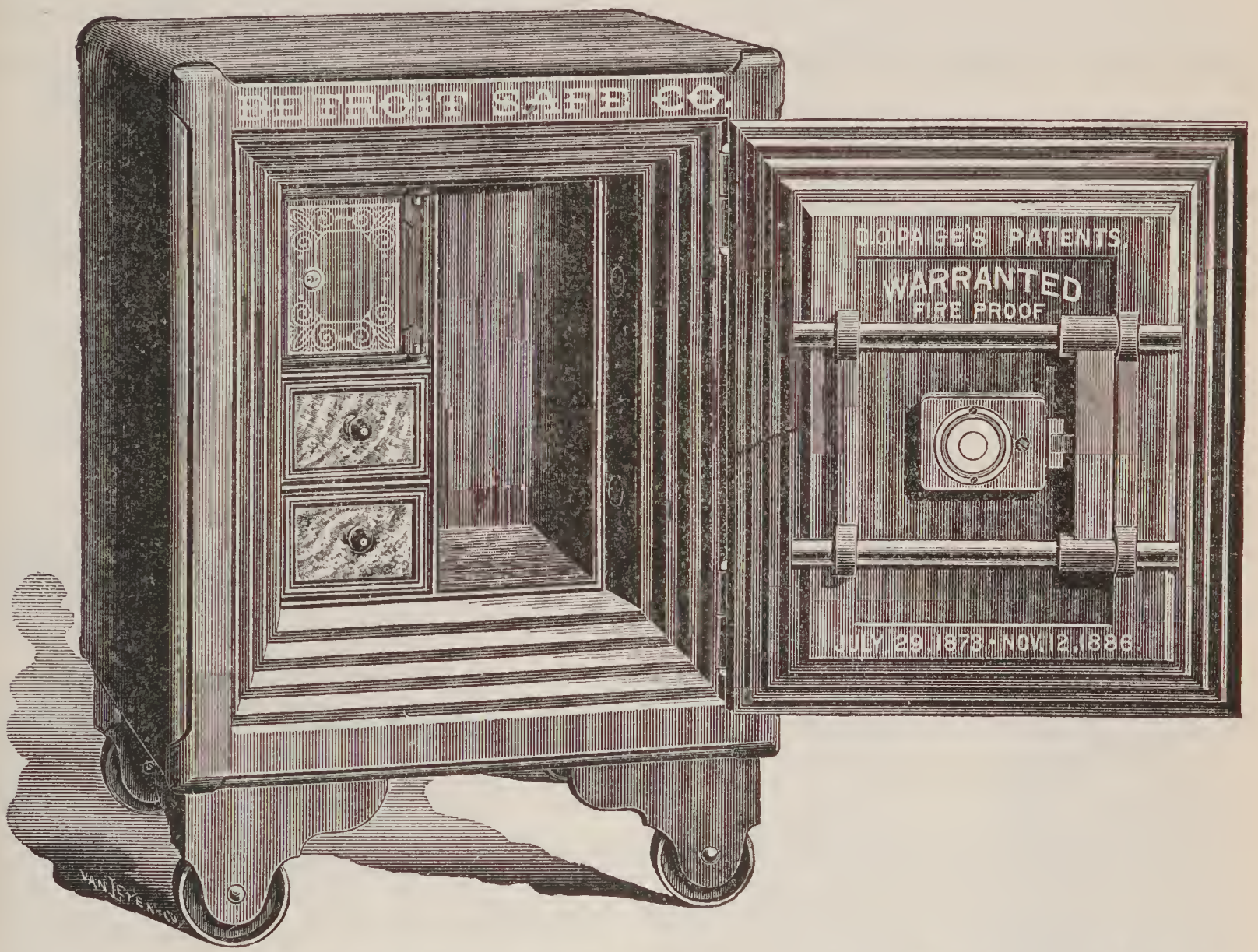

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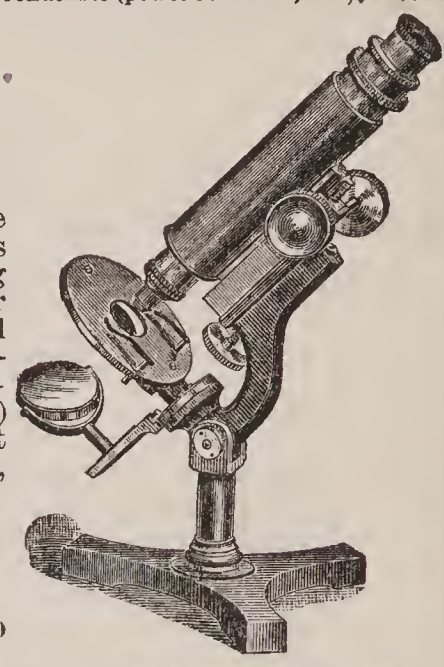

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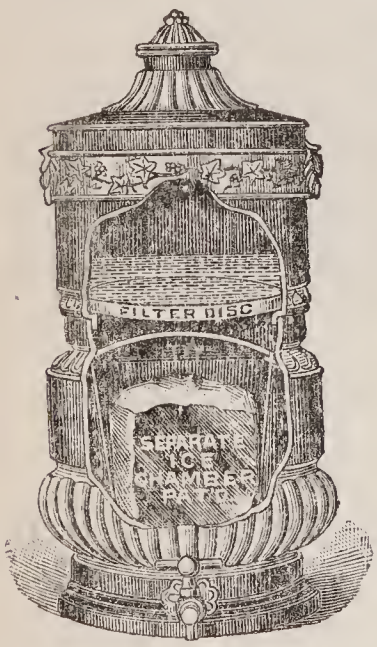

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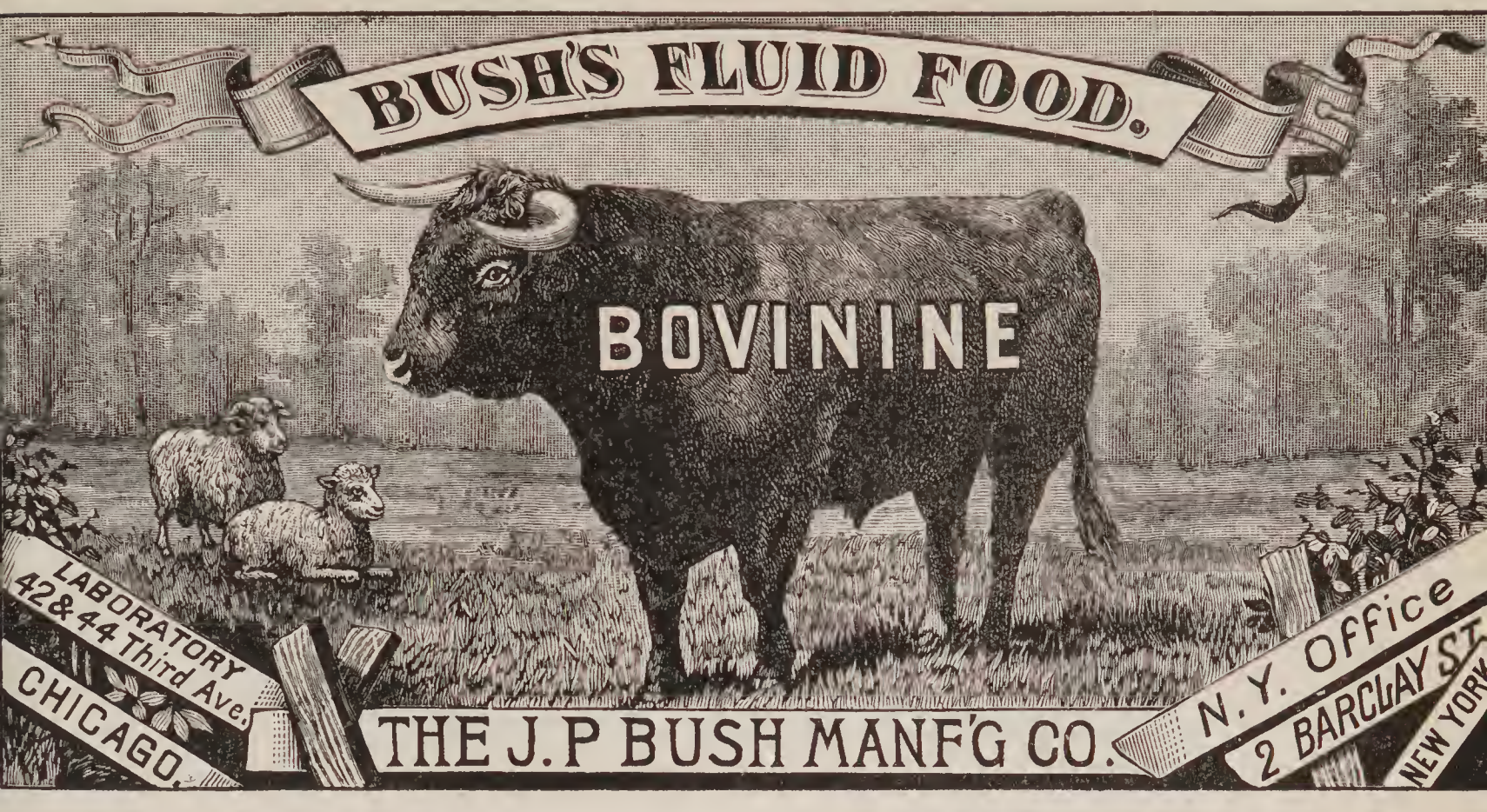

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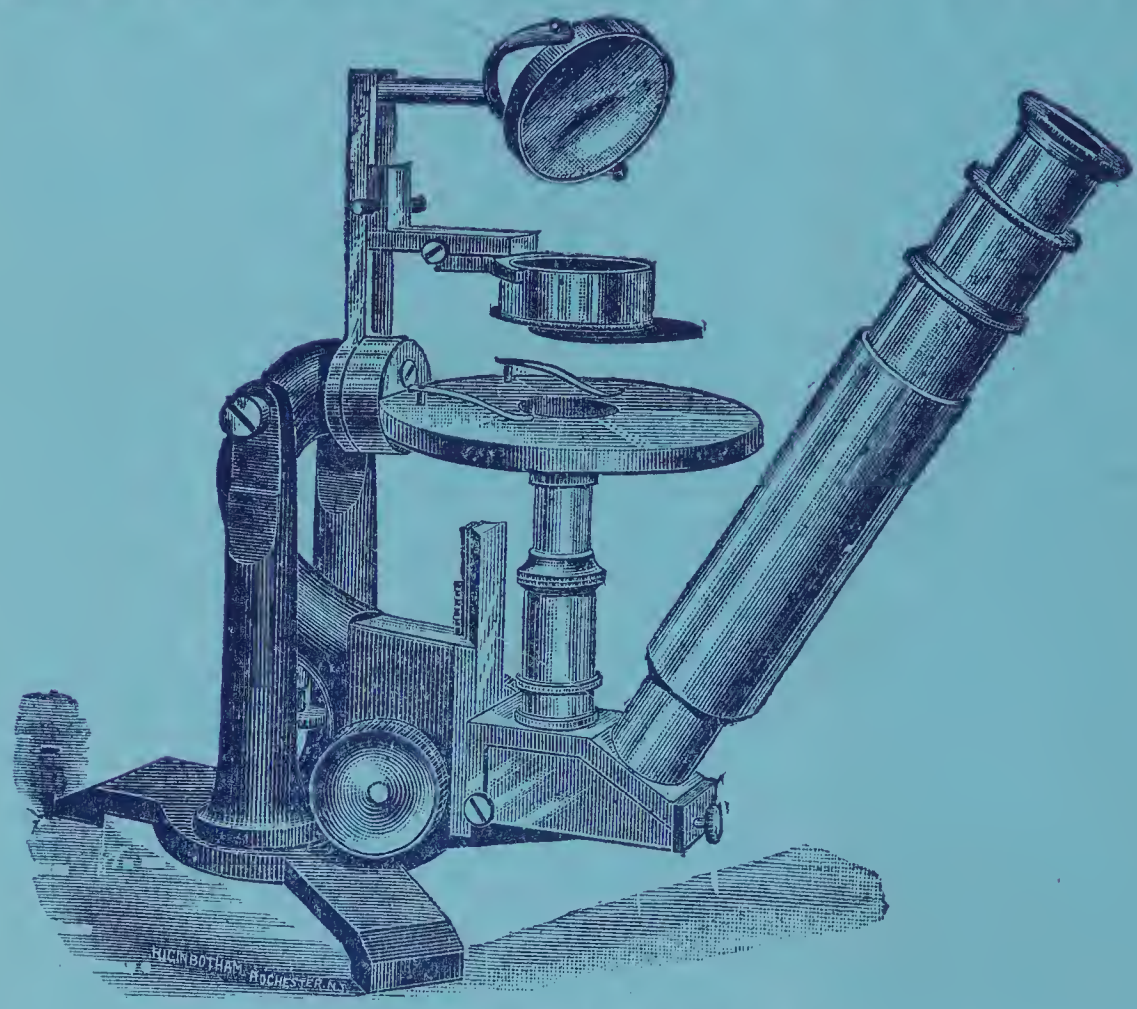

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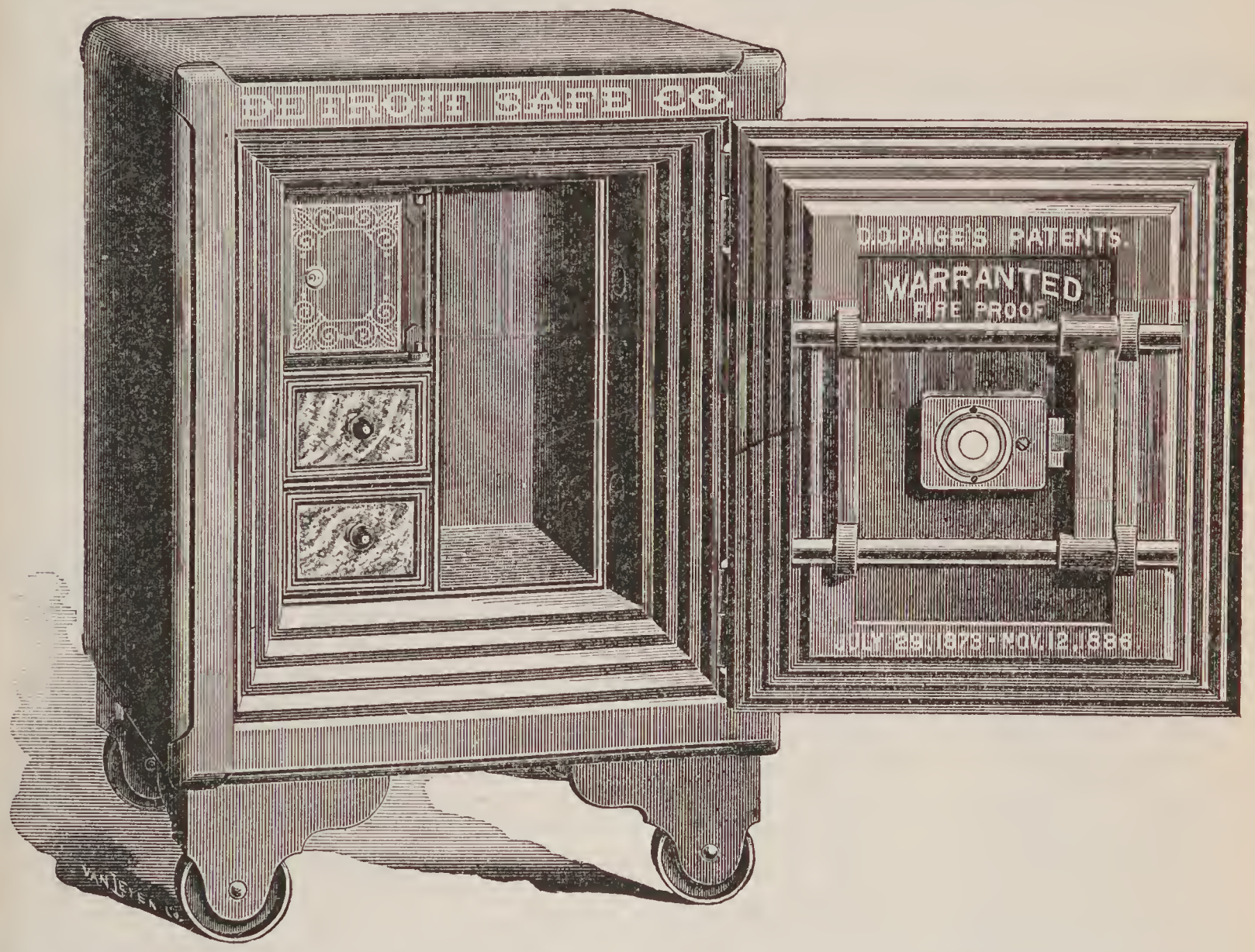

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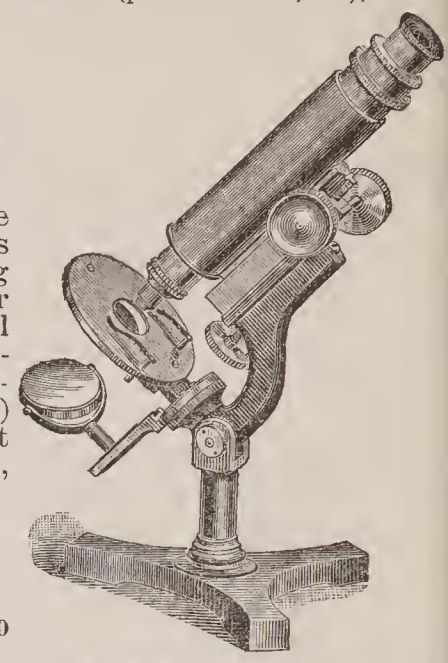

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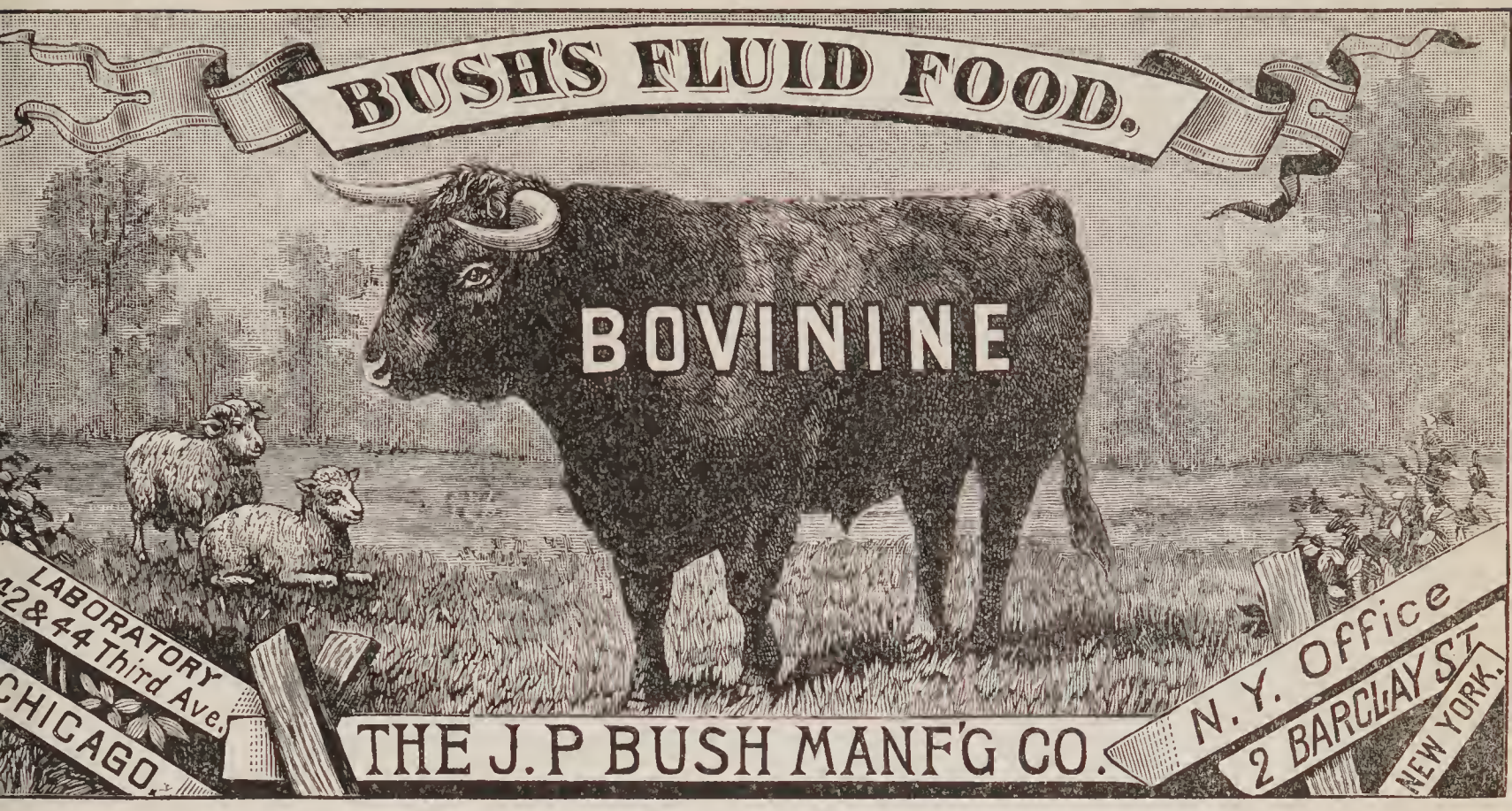

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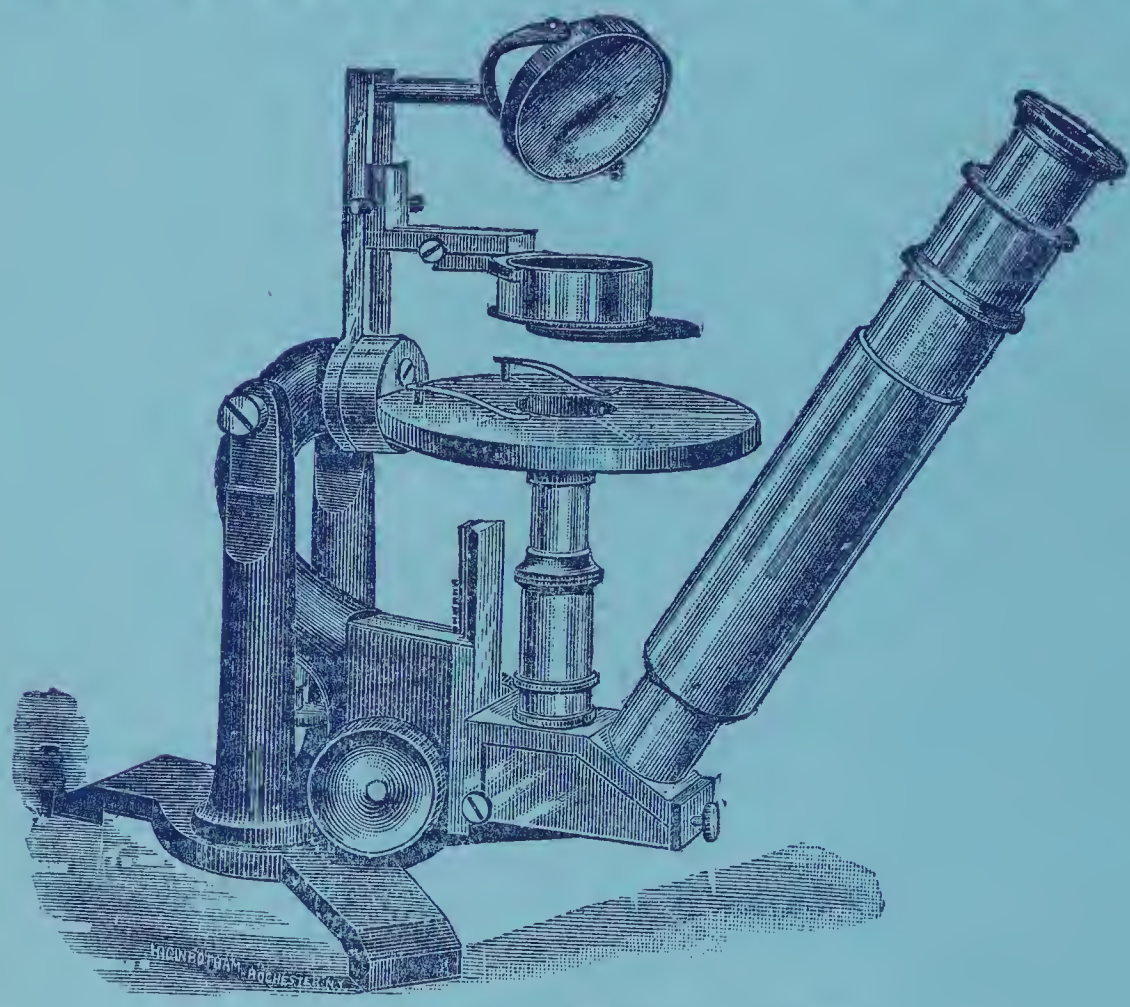

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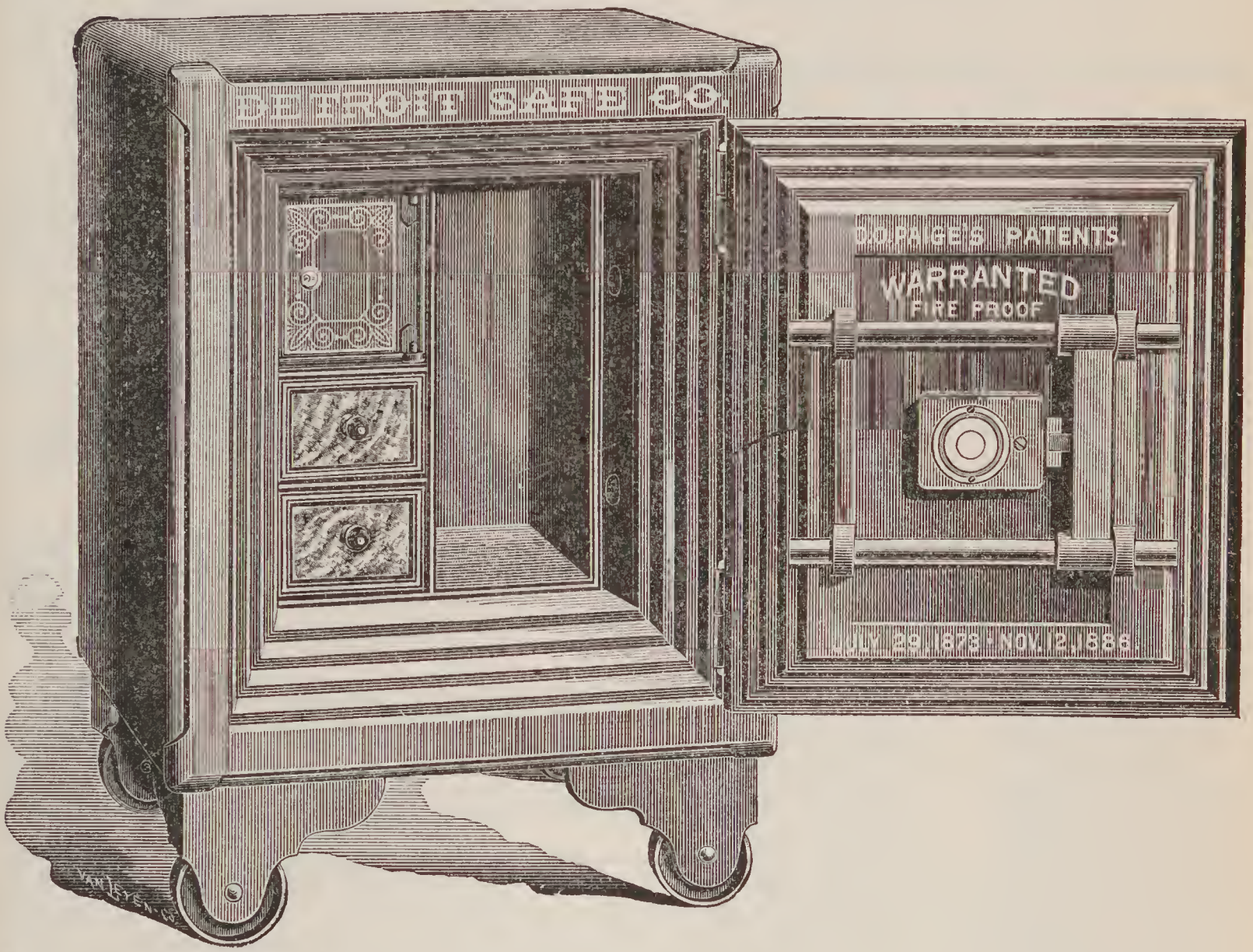

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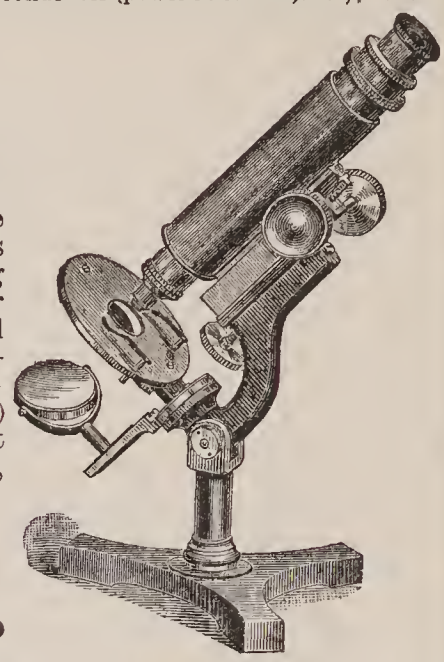

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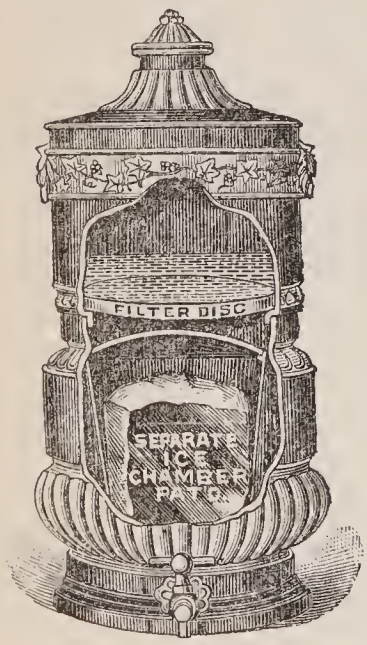

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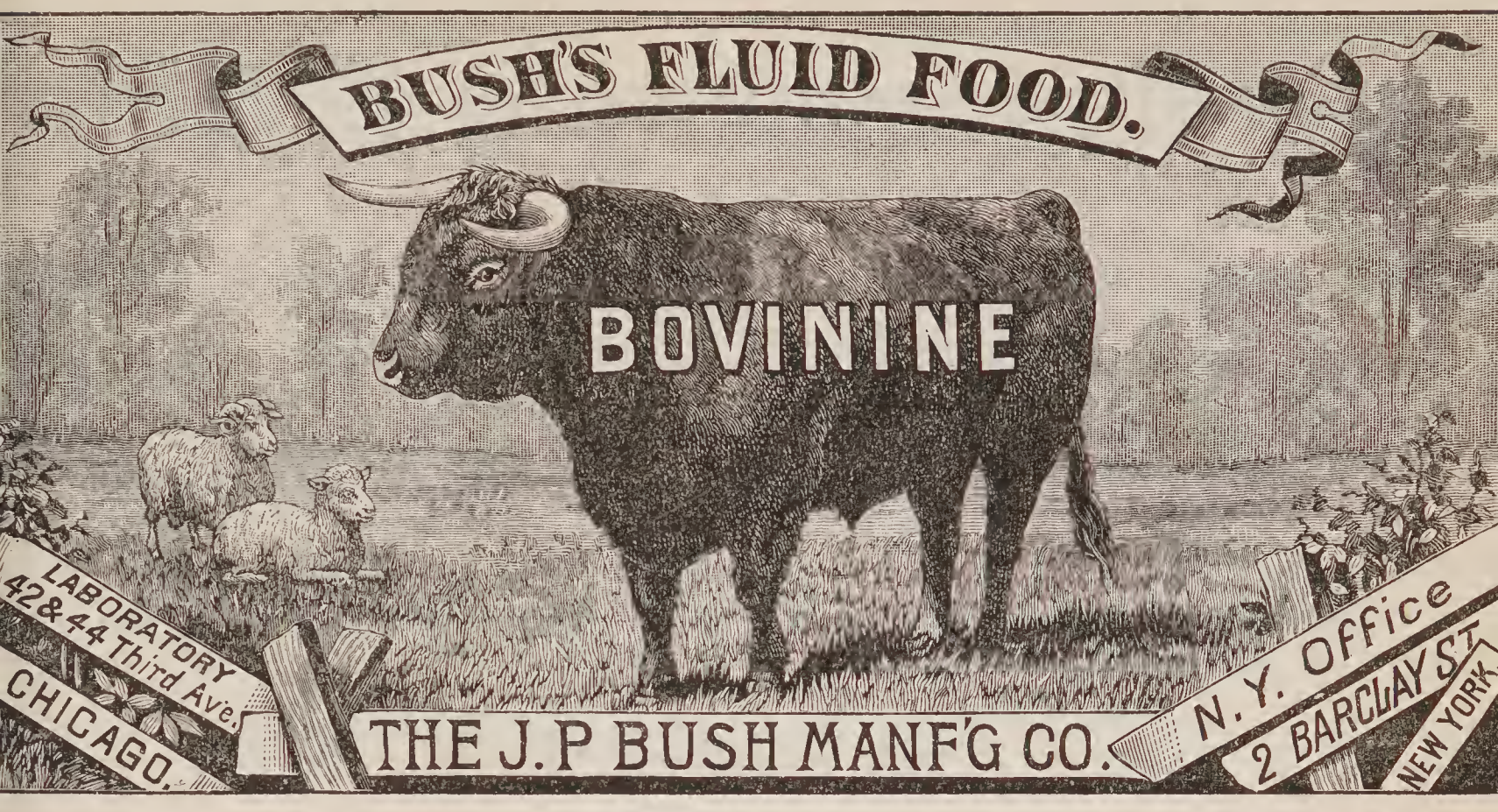

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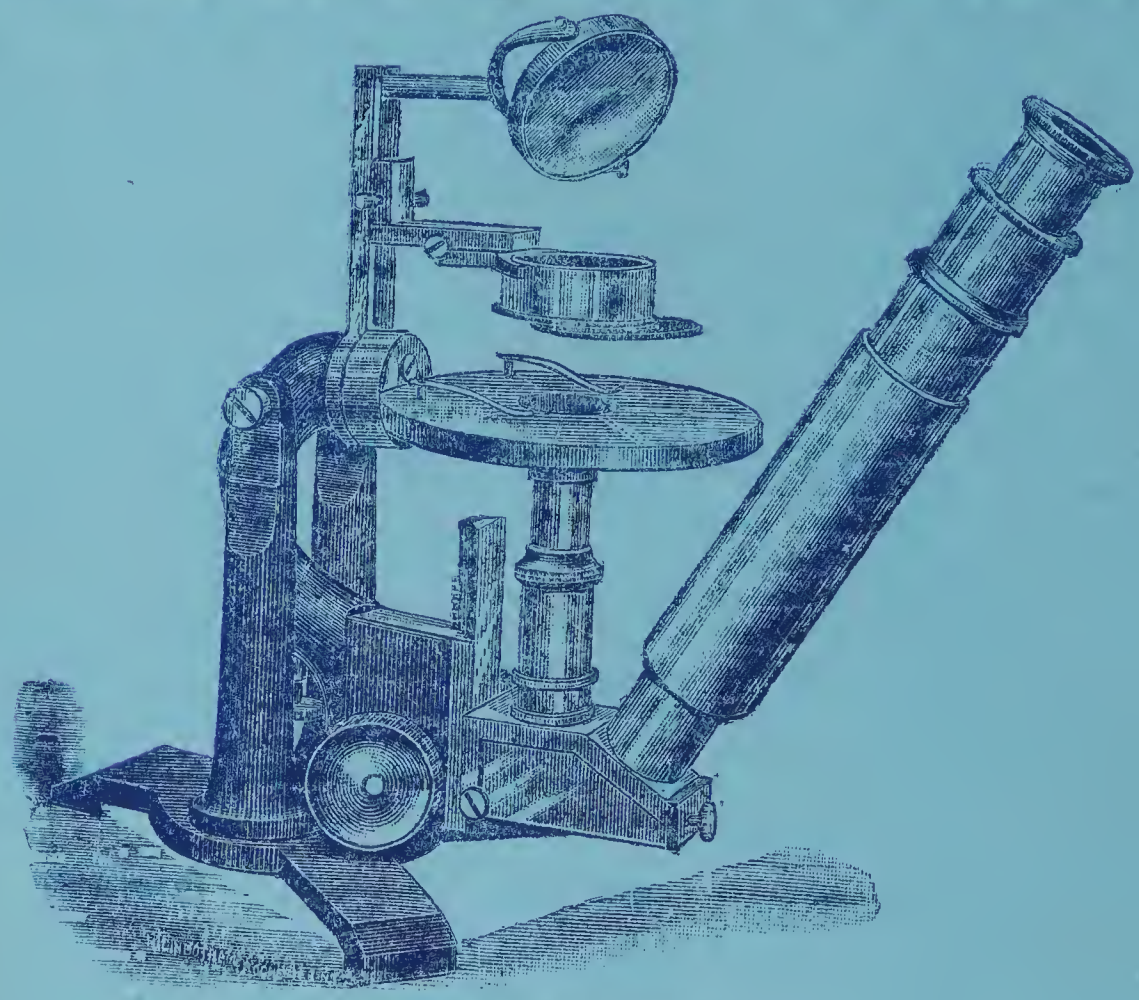

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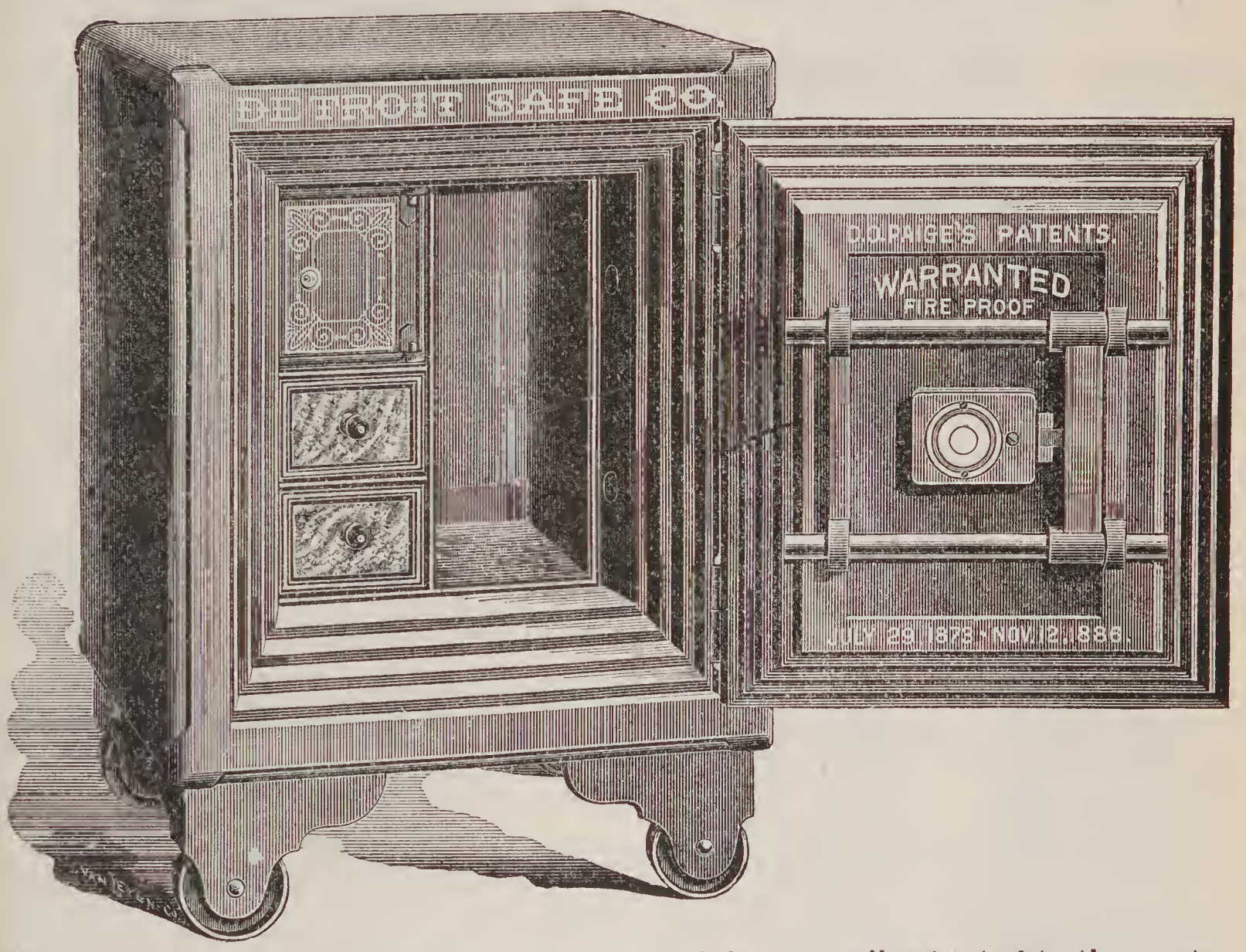

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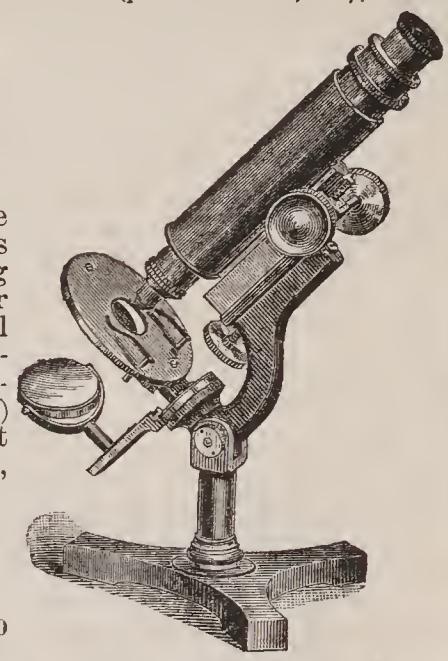

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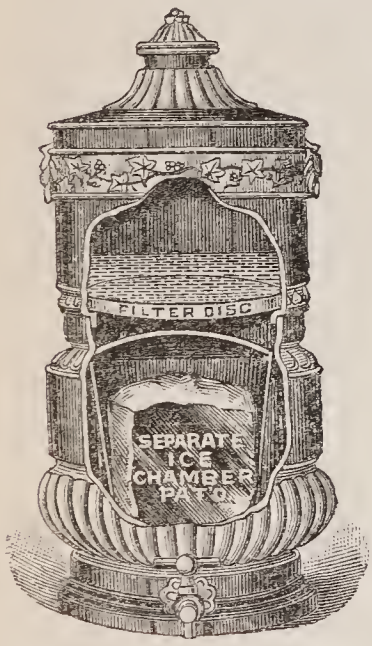

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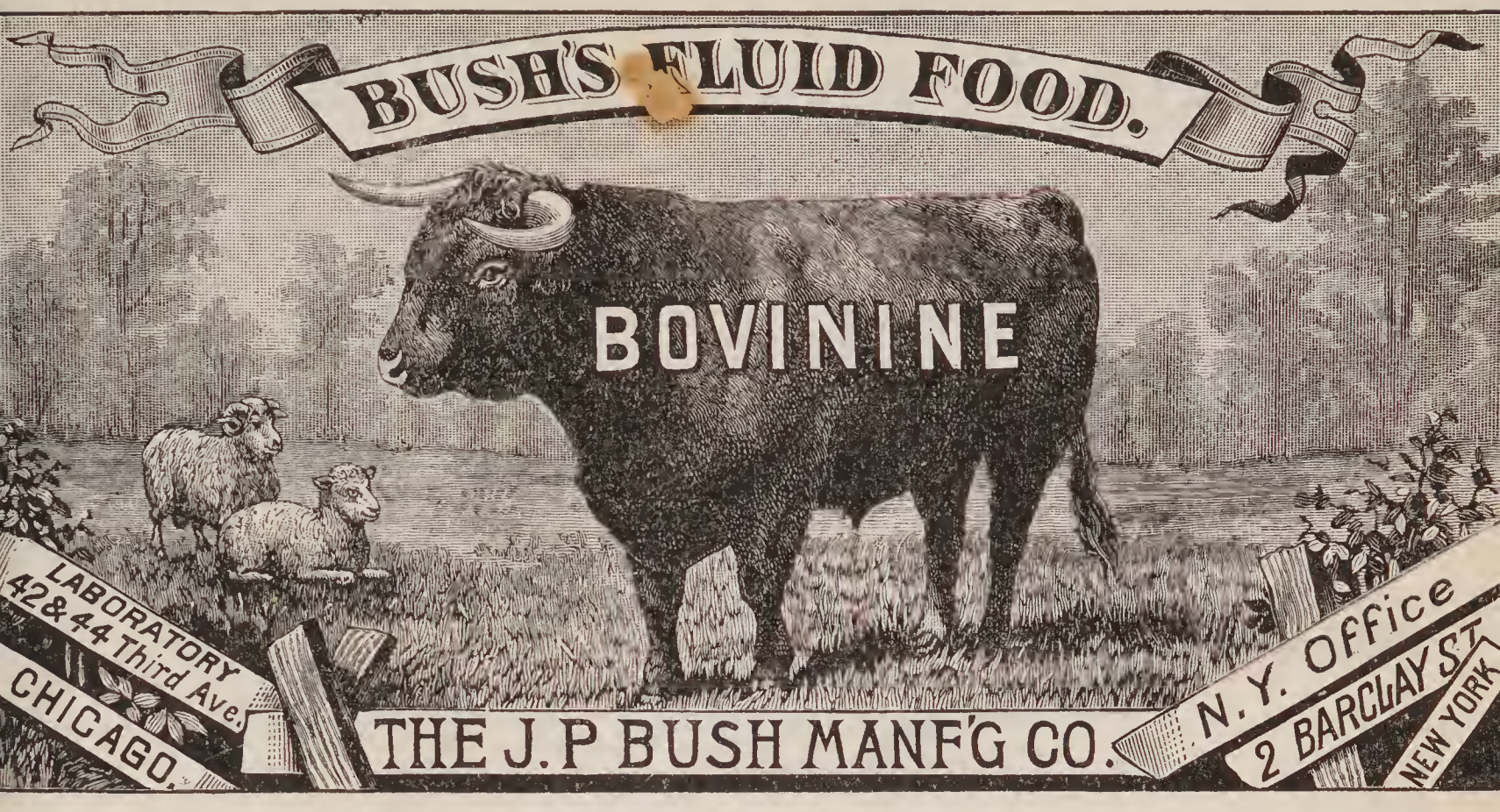

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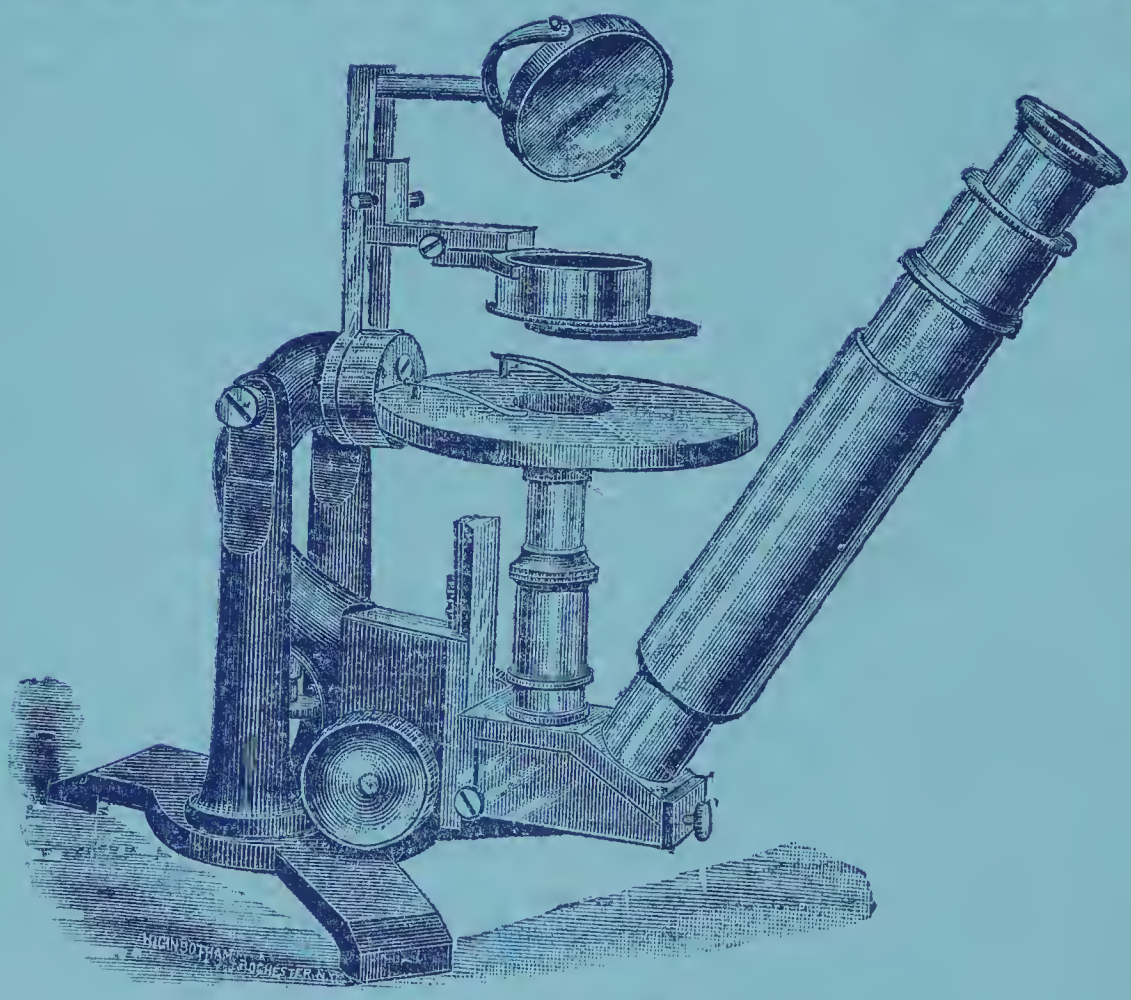

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